Compact Air Transportable Hospital Assessment

Final Report

March 1999

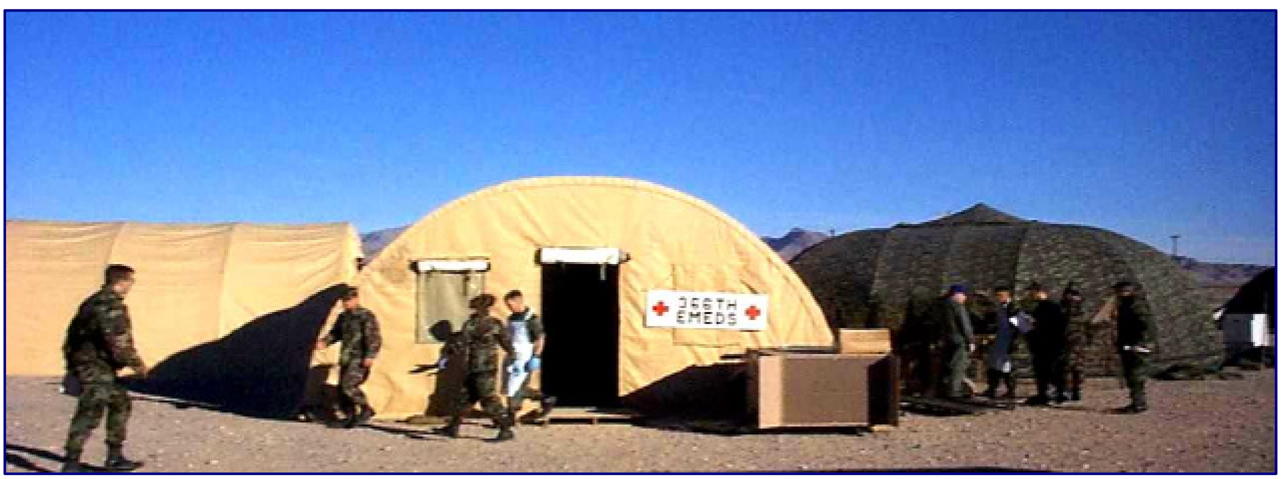
EXECUTIVE SUMMARY

The focus of this Air Expeditionary Force Battlelab (AEFB) Kenney Battlelab Initiative (KBI) was to demonstrate the military utility and medical adequacy of a Compact Air Transportable Hospital (CATH) to provide forward resuscitative surgical support for Air Expeditionary Force (AEF) Expeditionary Medical Support (EMEDS) operations. The shelter capability and medical equipment selected for EMEDS must be lightweight and deployable in no more than three 463L pallets aboard AEF aircraft. The shelters currently available for medical use are the Tent Extendable, Modular, Personnel (TEMPER) shelter and an Expandable Shelter Container (ESC) to house the surgery function. The TEMPER/ESC configuration for EMEDS occupies two and one-half pallet spaces, leaving little room for transport of required medical equipment and supplies. Therefore, an alternative shelter system is needed to meet the AEF reduced pallet size requirements while still providing the capability to meet EMEDS medical functionality requirements.

To assess candidate systems, a prototype Advanced Surgical Suite for Trauma Casualties (ASSTC), jointly developed by the United States Marine Corps (USMC) and the United States Army, was deployed to Nellis AFB, Nevada, and placed together in a configuration with two new United States Air Force (USAF) Small Shelter Systems (SSS), also known as Alaska shelters. The SSS is the current USAF billeting shelter replacement for the U.S. military TEMPER shelter. The ASSTC configuration was operated alongside an alternative configuration consisting of three SSS shelters. The assessment of these two candidate configurations was conducted during the first week (31 January – 6 February 1999) of the Air Force Medical Service's Form, Fit, and Function Follow-on (F-4) Assessment.

The assessment of the CATH systems during the F-4 exercise at Nellis AFB was executed successfully.

- The EMEDS team had the opportunity to erect both shelter types and to use the two configurations to perform trauma surgery and other critical EMEDS functions.
- The assessment team gathered objective and subjective data regarding the two shelter configurations.
- The assessment team obtained inputs from the deployed medical professional team regarding pros and cons of both systems and recommendations for future Air Force procurement decisions regarding acquisition of a CATH shelter to support a deployed EMEDS team.
- The EMEDS team identified procedural efficiencies in completion of shelter setup and in performing the various EMEDS medical functions. These all help meet the KBI goal to determine time savings for establishing and operating a forward deployed surgical capability.
- The assessment identified potential airlift footprint savings through downsized pallet requirements.



The ASSTC (on right) and SSS shelters used by the 366 Wing EMEDS during the F-4 Assessment.

Shelter Feature or Function Performed	Rating		
	ASSTC Configuration	SSS Configuration	TEMPER/ESC
Accommodation of EMEDS Medical Functions	○	◒	◒
Pallets Required	◒	⊙	●
Cost	○	◒	◒
Ease/Time of Setup	◒	◒	-
Environmental Factors	◒	◒	○

Rating Guide

⊙	Excellent	Excellent functionality was demonstrated.	●	Unsatisfactory	Unsatisfactory functionality. Problems serious and probably not correctable.
◒	Good	Good functionality was demonstrated. Problems correctable or not operationally significant.	-	Unknown	Little or no data available. Meaningful assessment not possible.
○	Questionable	Questionable functionality. Significant rework and reassessment required.	X	Not Applicable	System or function did not participate in event.

The Small Shelter System configuration was clearly preferred by the EMEDS team.

> ***The assessment results reflected a strong preference by the EMEDS team personnel for the SSS configuration rather than the ASSTC configuration as a potential medical shelter replacement for the currently used TEMPER/ESC configuration.***

This preference was based primarily on the ability of the SSS shelter configuration to support EMEDS functions. The medical personnel also provided recommendations that include a modification package to the SSS shelter to make it more satisfactory for EMEDS operations (e.g., improved flooring, better entrances, enhanced lighting, and a "surgery suite").

The assessment and this *CATH Assessment Final Report* were accomplished by Detachment 1 Air Force Operational Test and Evaluation Center (Det 1 AFOTEC) in support of the AEFB. The Battlelab's *After Initiative Report* format is used. The purpose of the report is to describe the field assessment activities, summarize the data collected, and provide assessment results for review, discussion, and consideration by Air Force decision makers involved in procurement decisions for future medical equipment to support EMEDS.

The ASSTC surgical suite received mixed reviews.

TABLE OF CONTENTS

Demonstration Mission Statement

The focus of this USAF Air Expeditionary Force Battlelab (AEFB) Kenney Battlelab Initiative (KBI) was to demonstrate military utility and medical adequacy of alternatives for a Compact Air Transportable Hospital (CATH) for rapid medical support of deploying forces worldwide. The selected technology must be easily transportable, provide a minimum footprint, and provide enhanced capabilities for surgical trauma operations as well as other medical functions required for support to the AEF forces.

Course of Action

The assessment team conducted a comparative assessment between configurations of the Small Shelter System (SSS) and the Advanced Surgical Suite for Trauma Casualties (ASSTC). The assessment examined pallet requirements, shipping and deployed size, environmental factors, and the ability of the shelter configurations to support Expeditionary Medical Support (EMEDS) medical functionality requirements.

Results

Shelter Feature or Function Performed	Rating		
	ASSTC Configuration	SSS Configuration	TEMPER/ESC
Accommodation of EMEDS Medical Functions	Questionable	Good	Good
Pallets Required	Good	Excellent	Unsatisfactory
Cost	Questionable	Good	Good
Ease/Time of Setup	Good	Good	–
Environmental Factors	Good	Good	○

Rating Guide

Excellent	Excellent functionality was demonstrated.	Unsatisfactory	Unsatisfactory functionality. Problems serious and probably not correctable.
Good	Good functionality was demonstrated. Problems correctable or not operationally significant.	- Unknown	Little or no data available. Meaningful assessment not possible.
Questionable	Questionable functionality. Significant rework and reassessment required.	X Not Applicable	System or function did not participate in event.

The EMEDS team, AEFB personnel, and a Det 1 AFOTEC assessment team deployed to Nellis AFB, NV, during the Air Force Medical Service's Form, Fit, and Function Follow-on (F-4) Assessment. Objective and subjective data supporting measures of effectiveness were gathered to conduct a comparative assessment of candidate shelter configurations. The medical team preferred the SSS configuration over the ASSTC configuration. This preference was based primarily on ease of setup and the ability of the system to support all EMEDS functions.

Recommendations

The recommendations of the EMEDS team provide Air Force decision-makers with information regarding potential improvements to the SSS to better qualify the system to fulfill all EMEDS requirements. Improvement categories and recommendations include structure, environmental control, and power.

Annexes

Cover: The CATH candidate EMEDS shelters at the Nellis AFB assessment location.

LIST OF TABLES AND FIGURES

List of Tables

List of Figures

DEMONSTRATION MISSION STATEMENT

Purpose

Air Force equipment used for recent deployable field surgical operations includes a mix of two Tent, Extendable, Modular, Personnel (TEMPER) shelters (see Figure 1) and one Expandable Shelter/Container (ESC) Industrial Standards Organization (ISO) shelter. The purpose of this assessment was to determine if either of two candidate replacement shelter systems could more adequately serve field patient care and surgical needs as well as reduce the lift and pallet space required to deploy an Expeditionary Medical Support (EMEDS) team.

The candidate replacement systems were the Advanced Surgical Suite for Trauma Casualties (ASSTC) and the Small Shelter System (SSS) shown in Figures 2 and 3. Both systems were transported, set up, and used for field patient care and surgical operations for one week as part of the U.S. Air Force medical community's Form, Fit, and Function Follow-on (F-4) exercise at Nellis AFB, NV. This report provides the results of that assessment and includes TEMPER/ESC (ISO) shelter data for comparison purposes.

Length of Time

Kenney Battlelab Initiative (KBI) approval – 25 November 1998

Figure 1. TEMPER tents erected for recent Mountain Home AFB medical exercise.

Estimated KBI completion – May 1999
From approval to completion – six months

Objectives and Measures of Merit

The objectives and measures for this assessment were developed to attain the stated AEFB KBI mission:

> ***Demonstrate the military utility of a compact, lightweight deployable Advanced Surgical Suite for Trauma Casualties (ASSTC) to provide forward resuscitative surgical support for Air Expeditionary Force operations.***

Objectives and measures of effectiveness (MOE) (see Table 1) were in turn developed by the evaluation team.

Figure 2. ASSTC shelter erected at Nellis AFB F-4 site, Camp COBRA.

Figure 3. SSS shelter in use at F-4 site.

Table 1. Objectives and Measures of Effectiveness for the CATH Demonstration

OBJ 1: Determine and compare the medical functionality of the ASSTC and SSS shelter configurations for the EMEDS mission.
MOE 1-1: Ability to conduct autonomous seven-day sustained operations and the ability to conduct 10 major trauma surgeries or 20 non-operative trauma resuscitations over a 48-hour period.
MOE 1-2: Ability to accommodate patient sick call.
MOE 1-3: Ability to accommodate triage.
MOE 1-4: Ability to accommodate stabilization and holding.
MOE 1-5: Ability to accommodate patient prep and anesthesia.
MOE 1-6: Ability to accommodate trauma surgery.
MOE 1-7: Ability to accommodate post-op recovery.
MOE 1-8: Ability to accommodate ortho/dental surgery.
MOE 1-9: Ability to accommodate casualty flow.
OBJ 2: Determine and compare the deployment footprints of the ASSTC, SSS, and TEMPER/ESC shelter configurations for the EMEDS mission.
MOE 2-1: Shipping weight for each of the three shelter configurations.
MOE 2-2: Shipping volumes for each of the three shelter configurations.
MOE 2-3: Pallet space required to ship each of the three shelter configurations.
OBJ 3: Identify and compare estimated component cost and additional cost factors associated with the ASSTC, SSS, and TEMPER/ESC shelter configurations.
MOE 3-1: Purchase cost of each of the three equivalent shelter configurations.
MOE 3-2: Shipping cost of each of the three equivalent shelter configurations.
MOE 3-3: Other cost factors for each of the three equivalent shelter configurations.
OBJ 4: Determine and compare the operational utility of the ASSTC and SSS shelter configurations to provide a ready-to-operate EMEDS capability in a reduced timeframe, the ability to sustain EMEDS operations, and the ability to redeploy/reconstitute.
MOE 4-1: Time required to erect the shelters and declare ready for emergency operations.
MOE 4-2: Identify any interface issues that affect employment of the shelter configurations (e.g., electrical, power, generators, water, or ground handling equipment).
MOE 4-3: Ability of the configurations to sustain EMEDS operations and to be reconfigured for other EMEDS missions.
MOE 4-4: Ability to tear down and reconstitute.
OBJ 5: Determine and compare the operational environmental control factors of the ASSTC and SSS shelter configurations.
MOE 5-1: Ability of shelter configurations to maintain a suitable temperature range for medical procedures.
MOE 5-2: Ability of shelter configurations to maintain suitable humidity levels for medical procedures.
MOE 5-3: Ability of shelter configurations to sustain adequate illumination levels for medical procedures.
MOE 5-4: Ability of shelter configurations to sustain adequate noise suppression levels for medical procedures.
MOE 5-5: Ability of shelter configurations to provide a physical barrier to the outside environment to prevent infiltration of dirt, sand, water, and insects into the interior.
MOE 5-6: Ability of the shelter configuration ECUs [environmental control units] to adequately filter particulates, such as sand, dust, and pollens to a level compatible with safe medical operations.

COURSE OF ACTION

The Air Expeditionary Force Battlelab (AEFB) Compact Air Transportable Hospital (CATH) KBI described a three-step process for the KBI course of action.

Step 1: Conduct basic requirements analysis and establish guidelines for AEF medical support and structure of EMEDS (AEF VII, August 98).

Step 2: Integrate the ASSTC and SSS into the EMEDS package.

Step 3: Conduct a field evaluation under an AEF deployment scenario. The F-4 medical deployment exercise at Nellis AFB (February 99) was used to evaluate the ASSTC and SSS.

Steps 1 and 2 were accomplished by the AEFB in conjunction with 366th Wing Medical Group personnel and members of the Air Force ATH-X Integrated Process Team (IPT). The IPT met during and following the CATH field event, and the IPT results directly related to this initiative are included in Annex I of this report.

This *CATH Assessment Final Report* addresses Step 3, Field Evaluation, which was accomplished at Nellis AFB during 31 January – 6 February 1999.

To execute the CATH assessment, the 24-person EMEDS team deployed to Nellis AFB, NV, on 30 January 1999. At the Nellis AFB Area 2 mobility exercise area, designated Camp COBRA (see Figure 4), the EMEDS team set up, configured, and operated out of shelters. The team integrated with the F-4 Mission Exercise Control Cell at the Nellis test site (see Figure 5).

Execution Summary

F-4

The Form, Fit, and Function Follow-on Assessment was designed to comply with the Headquarters United States Air Force Surgeon General/Plans (HQ USAF/SGX) objective to evaluate the Air Force Medical Service's (AFMS) new medical specialty sets. The purpose of the test was to thoroughly assess the functional capabilities and limitations of each set and how each can be optimally and efficiently integrated into the appropriate increment(s) of an air transportable hospital (ATH) and hospital surgical expansion package (HSEP). The test consisted of deploying, employing, and redeploying components of the AFMS to interact, train, and evaluate the ability of equipment assemblages to provide for medical support during contingency operations. All F-4 operations occurred entirely within the confines of Nellis AFB, NV.

Evaluation Method

Detachment 1 Air Force Operational Test and Evaluation Center (Det 1 AFOTEC) served as the assessment lead, working closely with the AEFB

Figure 4. Entrance to the Nellis AFB Camp COBRA F-4 Assessment area.

Figure 5. CATH data collectors operated with F-4 Exercise Control Cell.

and 366th Wing EMEDS team to develop baseline (current and proposed Air Force shelter) data, deconflict exercise procedures with assessment requirements, and develop assessment methodology. Military medical professionals on the EMEDS team with deployment experience were the primary assessors of equipment suitability, capability, and compatibility. Cost and footprint data were obtained from existing documentation, while military utility and medical adequacy were demonstrated and assessed during the F-4 Assessment at Nellis AFB.

Medical procedures outlined in the draft *ACC Concept of Operations (CONOPS) for Expeditionary Medical Support (EMEDS) and Air Force Theater Hospitalization (AFTH)*, December 1998, were conducted in two deployed shelter configurations during F-4. One configuration included the ASSTC while the other used the new Air Force SSS to provide an alternative for comparison. Surgical procedures were conducted in both shelters using moulaged mannequins (see Figure 6) and/or animals to validate the surgical suite and to assess potential ASSTC advantages, if any, over the SSS.

All data were returned to Det 1 facilities at Kirtland AFB, NM, for compilation, analysis, and report preparation. Original data and summary data products were provided to the AEFB.

Data regarding TEMPER/ESC size, weight, shipping requirements, and costs were provided to the assessment team by the AEFB to facilitate shelter comparisons for Objectives 2 and 3.

System Descriptions

The ASSTC system was developed to enable rapid deployment of battlefield resuscitative surgery and trauma care. The ASSTC transport box is 5’x5’x10’ and weighs 3,600 pounds. Approximately 1,000 pounds of additional equipment can be carried internally. The deployed system consisted of one 9’x12’ surgical suite, triage area, holding area for six patients, environmental control unit (ECU) providing positive pressure for nuclear/biological/chemical (NBC) protection, lighting, and storage compartments.

Figure 6. Sick call in the SSS shelter.

The SSS is being developed under the USAF Small Shelter System Development Program by the Air Base Systems Program Office at Eglin AFB, FL. It was selected after a competition with other shelters and is currently undergoing combined developmental test and evaluation/initial operational test and evaluation (DT&E/IOT&E). The SSS is designed as a personnel billeting system for USAF deployed bare-base operations. It is procured with a Mobility Readiness Spares Package (MRSP) as standard equipment, but since the MRSP is not required for deployed EMEDS purposes, it was not included in the CATH assessment.

Additional information on both shelters is contained in Annex B.

RESULTS

Overview

The two candidate shelter systems and the 24-person EMEDS team successfully deployed to Camp COBRA, Nellis AFB, on 31 January 1999 and successfully operated there through 6 February 1999. Medical operations conducted during the week included the full range of patient care from triage through surgery to post-op disposition.

This section is devoted to a detailed discussion of initiative results. Figure 7 provides a summary of those results and a comparison of experience with the current TEMPER/ESC (ISO) configuration. Although a TEMPER tent configuration was not evaluated during the CATH field demonstration, existing data and EMEDS team personnel experience are available to provide comparative data, particularly in the areas of footprint (Objective 2) and costs (Objective 3).

Initiative Results

Objective 1: Determine and compare the medical functionality of the ASSTC and SSS shelter configurations for the EMEDS mission.

The assessment of medical functionality was accomplished as medical activities were performed by the EMEDS during the field demonstration. These activities (e.g., sick call) were performed using two separate shelter configurations.

- The <u>ASSTC Configuration</u>: consisting of the ASSTC shelter and two SSS shelters (SSS #1 and SSS #2) connected at a vestibule (see Figure 8). The surgery suite was contained in the ASSTC.

- The <u>SSS Configuration</u>: consisting of three SSS shelters connected at a vestibule (see

Shelter Feature or Function Performed	Rating		
	ASSTC Configuration	SSS Configuration	TEMPER/ESC
Accommodation of EMEDS Medical Functions	○	◓	◓
Pallets Required	◓	◉	●
Cost	○	◓	◓
Ease/Time of Setup	◓	◓	–
Environmental Factors	◓	◓	○

Rating Guide

◉	Excellent	Excellent functionality was demonstrated.
◓	Good	Good functionality was demonstrated. Problems correctable or not operationally significant.
○	Questionable	Questionable functionality. Significant rework and reassessment required.
●	Unsatisfactory	Unsatisfactory functionality. Problems serious and probably not correctable.
-	Unknown	Little or no data available. Meaningful assessment not possible.
X	Not Applicable	System or function did not participate in event.

Note: Shaded column for TEMPER tent indicates that the system was not part of the CATH Assessment. The data were provided by the AEFB for comparison purposes.

Figure 7. Summary of assessment results with comparison to current system.

Figure 9). The surgical suite was contained in SSS #3 (see Figure 10).

Many of the operator comments regarding the *ASSTC configuration* deal primarily with the ASSTC *shelter* portion of that configuration, particularly those comments dealing with space and patient movement. Surgery, along with pre-op/prep, post-op, some patient holding, and dental functions were performed in the ASSTC shelter for the ASSTC configuration. Other functions were performed in the SSS portion of the configuration.

EMEDS personnel (physicians, nurses, medical technicians, and other professional and support personnel) were the primary source of data for assessing medical functionality. Det 1 data collectors administered questionnaires to participants at the end of each day's activities (see Figure 11). Participants were contacted as necessary to clarify or expand on questionnaire entries. Data collectors also collected objective timing and environmental data and documented activities with video and still cameras. A "hot wash" debriefing was conducted by Det 1 at the end of the deployment to review results and gather general assessment information in a group setting.

EMEDS functional requirements were broken down into nine MOEs. The MOEs were assessed based on EMEDS team members' questionnaire responses following performance of the respective functions and on objective environmental data, where applicable. Figure 12 provides a summary of results for each of the Objective 1 MOEs. It illustrates the operators' strong preference for the SSS configuration.

Throughout this document, operator comments are summarized by shelter configuration following each MOE.

Measures of Effectiveness (Obj - 1)

MOE 1-1: *Ability to conduct autonomous, seven-day, sustained operations and the ability to conduct 10 major trauma surgeries or 20 non-operative trauma resuscitations over a 48-hour period.*

The majority of respondents felt strongly that the ASSTC would not support sustained trauma operations. Conversely, most agreed or strongly agreed that the SSS could support such operations (see Figure 13).

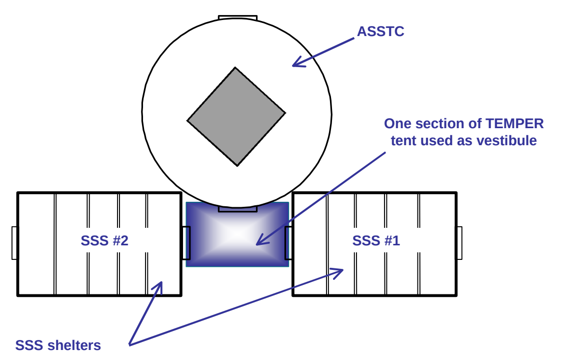


Figure 8. ASSTC configuration used for CATH demonstration.

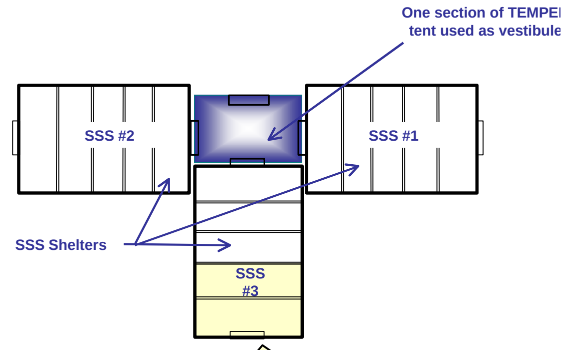


Figure 9. SSS configuration used for CATH demonstration.

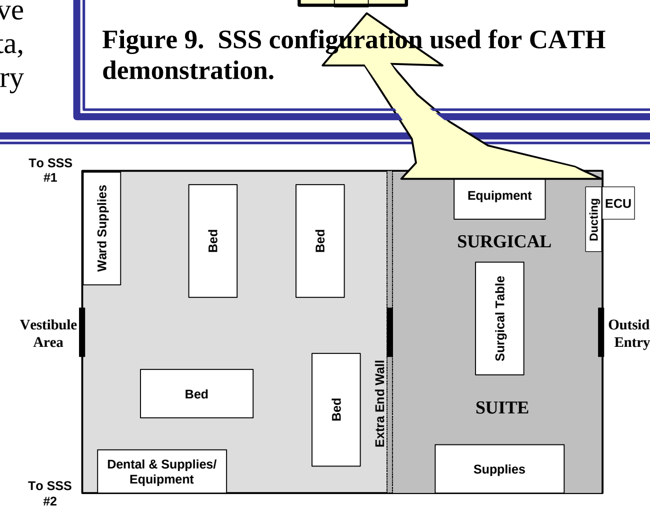


Figure 10. SSS #3 configured with surgical suite.

Figure 11. EMEDS team filled out questionnaires at end of each day.

ASSTC: The surgery suite (see Figure 14) is too cramped for conducting proper, efficient surgical procedures. In addition, the layout of the shelter around the surgical suite "box" makes it very difficult to use as a surgery and patient holding area and to monitor more than one patient per care giver. Additionally, members of the medical team indicated that it was difficult to maintain sterile areas in the ASSTC surgical "box." This was exacerbated by the concern that fluids from the surgery area could either leak under the floor and potentially onto electrical wiring or through the hinges onto the patient care area of the tent. In addition to the obvious health concerns, this problem could impact sustained operations because non-standard, bare-base structure and utility systems seriously reduce field repair and replacement capabilities.

From a positive perspective, the medical team thought the surgery table in the ASSTC was very good, as was the surgery area lighting (although one team member indicated that the lights should be changed to allow focus at 90 degrees down).

SSS: The medical team felt the SSS (see Figure 15) provided abundant room to perform two surgeries side by side and still have room for personnel to maneuver. However, the personnel would like the surgical area to be "sealable"

Demonstration MOEs - Objective 1	Rating	
	ASSTC Configuration	SSS Configuration
MOE 1-1: Ability to sustain operations/ 10 trauma/20 non-operative surgeries	○	◓
MOE 1-2: Ability to accommodate sick call	–	◓
MOE 1-3: Ability to accommodate triage	○	◓
MOE 1-4: Ability to accommodate stabilization & holding	○	◓
MOE 1-5: Ability to accommodate patient prep/anesthesia	○	◓
MOE 1-6: Ability to accommodate trauma surgery	○	◓
MOE 1-7: Ability to accommodate post-op recovery	○	◓
MOE 1-8: Ability to accommodate ortho/dental surgery	○	◓
MOE 1-9: Ability to accommodate casualty flow	○	◓

Rating Guide

● (green)	Excellent	Excellent functionality was demonstrated	○	Questionable functionality	Significant rework and reassessment required
◓	Good	Good functionality was demonstrated. Problems correctable or not operationally significant	●	Unsatisfactory functionality	Problems serious and probably not correctable
–	Unknown	Little or no data available. Meaningful assessment not possible	X	Not Applicable	System or function did not participate in event

Figure 12. Summary of Objective 1 measures of effectiveness.

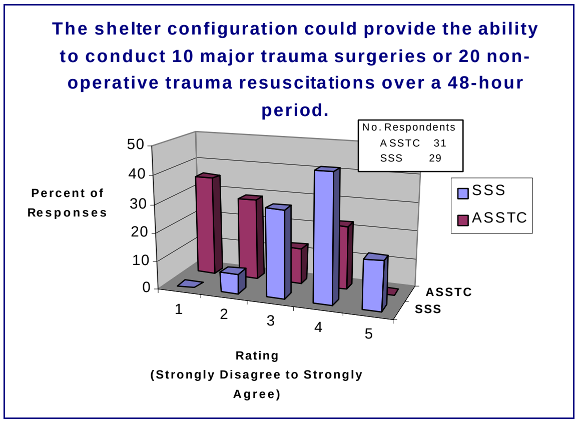


Figure 13. Participant ratings for MOE 1-1 show a decided SSS preference.

Figure 14. ASSTC surgical suite quarters were cramped.

environmentally. They emphasized that the doors were inadequate for patient transport/flow and that a two-way (swinging) door is a strongly desired requirement for improvement.

MOE 1-2: *Ability to accommodate patient sick call*.

Sick call was held in SSS #1 for both configurations. Based on operator debriefings and observation, the sick call function went smoothly.

MOE 1-3: *Ability to accommodate triage*.

ASSTC: Many operator comments regarding the ASSTC addressed the difficulty in moving litters through the facility. This was especially noticeable during triage. Additionally, operators observed that the facility provided no means to hang intravenous (IV) equipment.

SSS: Primary concerns expressed were the poor location of supplies, particularly for IVs, which may only have been a function of the EMEDS shelter configuration for the F-4 assessment. One operator noted that probably only three patients could be adequately triaged in the shelter.

MOE 1-4: *Ability to accommodate stabilization and holding*.

Figure 16 illustrates the responses of the medical team regarding the capabilities of the two shelter configurations to accommodate patient holding

Figure 15. Surgical team preparing for surgery in the SSS surgical suite configuration.

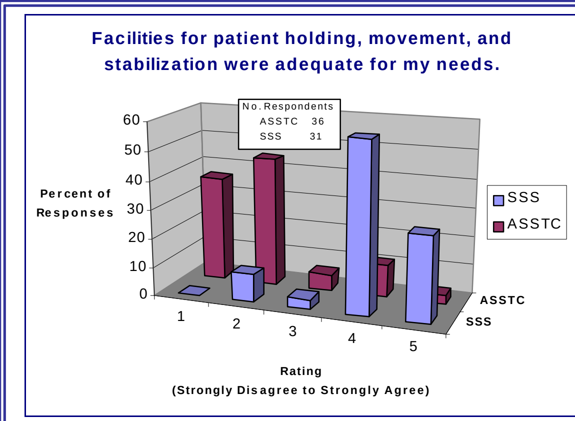


Figure 16. Strong participant responses for MOE 1-4 reflect the ASSTC floor space problem.

and stabilization. The strong preference for the SSS was largely due to the difficulty of seeing all beds in the ASSTC from one vantage point and to not being able to get to both sides of the bed to perform medical procedures.

<u>ASSTC</u>: Operators noted that the space in the patient holding area was extremely cramped and that moving patients from the operating room (OR) to a holding area was very difficult.

<u>SSS</u>: The operators were impressed that they had a good view that enabled them to see all patients at one time. They had good access to all patients, and all of the beds had power outlets available.

MOE 1-5: *Ability to accommodate patient prep and anesthesia.*

The responses of the medical team (see Figures 17, 18, and 19) again favored the SSS configuration for the function of patient preparation and anesthesia. This preference was particularly evident regarding the factors of adequate floor space (see Figure 18) and access to adequate storage (see Figure 19).

<u>ASSTC</u>: It was very difficult to get to both sides of the patient in the patient holding area. This made injections and putting in IV lines extremely awkward. Additionally, the storage was inefficient and personnel had to take many steps to get what was needed. Electrical lines were in the way, presenting a tripping hazard.

<u>SSS</u>: The operators commented that they could stand in the middle of four beds and see everything. The tripping hazard at the doors was again emphasized, as was inadequate lighting.

MOE 1-6: *Ability to accommodate trauma surgery.*

The ASSTC fared much better in the ratings for this function than for the other medical functions, especially regarding equipment availability (see Figure 20). However, the limited floor space allowed only one surgery table, which was considered inadequate by the surgical team (see Figure 21). Opinions were mixed regarding access to storage in the ASSTC, and some of the team felt

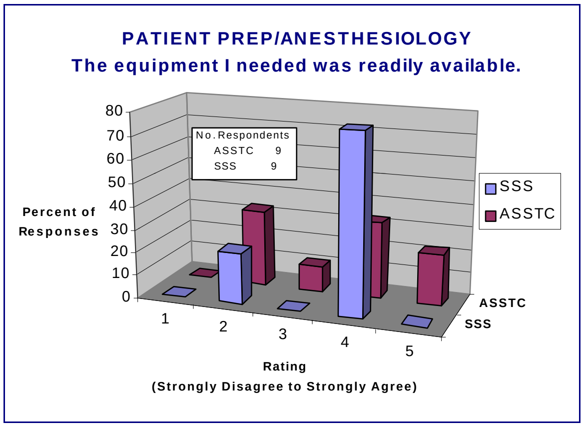


Figure 17. Equipment availability for patient prep was better in the SSS.

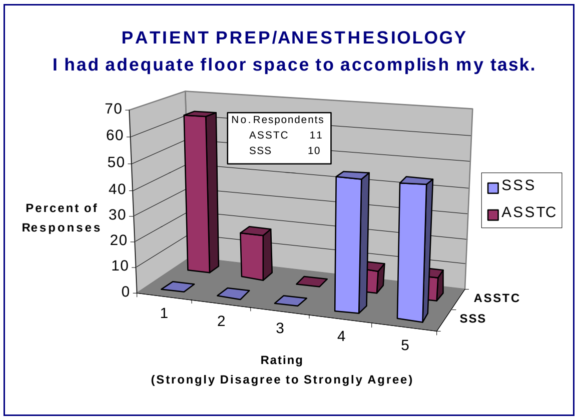


Figure 18. ASSTC floor space was a particular concern for patient prep.

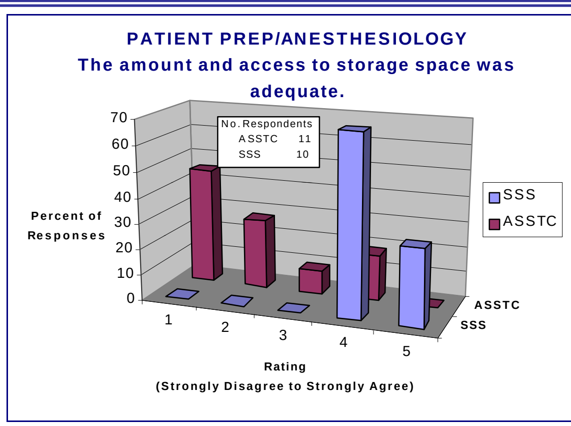


Figure 19. Storage space was also rated better in the SSS for patient prep.

strongly that the SSS filled this need better (see Figure 22).

MOE 1-7: *Ability to accommodate post-op recovery*.

Comments related to post-op were closely correlated to triage, pre-op, and patient movement. The SSS configuration was generally found to be suitable, while the ASSTC periphery was too crowded and dark for effectively performing the medical procedures.

MOE 1-8: *Ability to accommodate ortho/dental surgery*.

The number of dental operations performed during the assessment was very limited.

<u>ASSTC:</u> Comments reflected that the bed had to be pulled out in order to provide space to conduct dental operations. The bed then blocked the aisle.

<u>SSS</u>: The dental provider felt that the shelter provided a good setup with much flexibility. He also pointed out that the dental function could be located in another shelter of the configuration, if necessary, to better accommodate other medical functions.

MOE 1-9: *Ability to accommodate casualty flow*.

One team member indicated that the difficulty in conducting patient flow could endanger lives because it was sometimes difficult to ventilate patients throughout the move. This problem was a function of the specific shelter setups used during F-4 and the narrow three-foot SSS doors, which applied to both configurations.

<u>ASSTC</u>: The EMEDS personnel encountered a severe problem in efficiently moving patients around the ASSTC periphery and in positioning cots and patients properly.

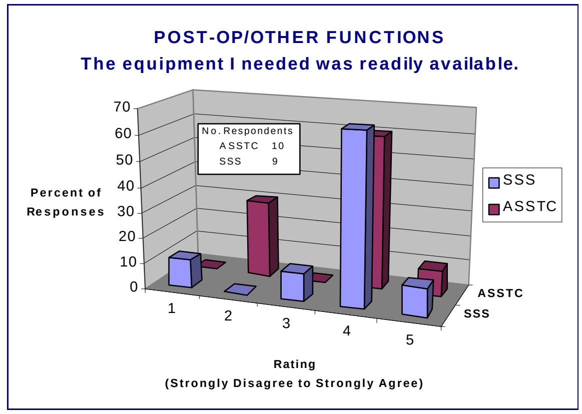


Figure 20. Equipment availability during surgery was rated positively for both systems.

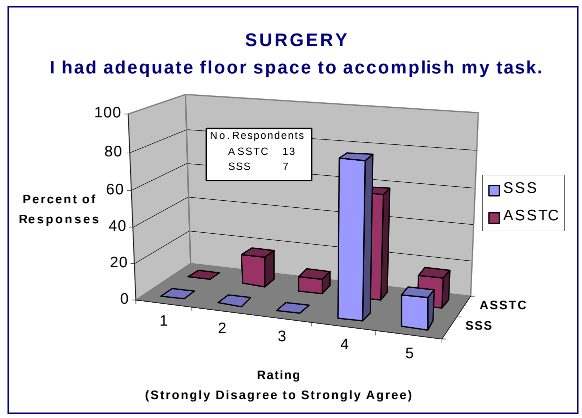


Figure 21. Floor space was not adequate in the ASSTC surgical suite.

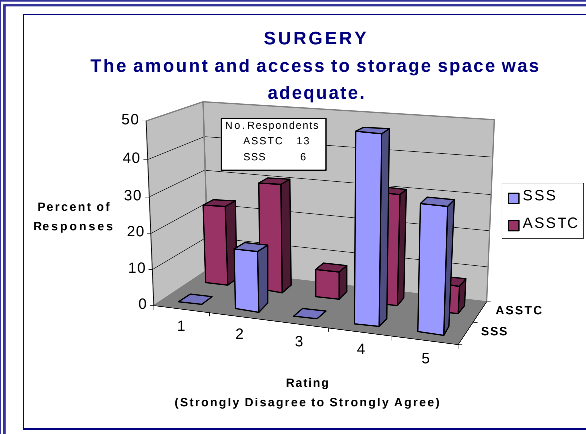


Figure 22. Opinions were mixed on ASSTC surgical suite storage space.

Objective 2: Determine and compare the deployment footprints of the ASSTC, SSS, and TEMPER/ESC shelter configurations for the EMEDS mission.

Measures of Effectiveness (Obj - 2)

Table 2 provides a side-by-side configuration comparison of all the MOEs for this objective (weight, volume, and pallet space). The subtotal values in the table reflect shelter configurations only, without ECUs. The complete configuration values include ECUs. Detailed tables for each MOE are provided in Annex F.

MOE 2-1: *Shipping weight of each of the three shelter configurations*.

As evidenced in Table 2, the SSS configuration is considerably lighter than either of the other two configurations by a factor of 1.32 for the ASSTC and 1.72 for the TEMPER. The subtotal weights show that the ASSTC configuration (ASSTC plus two SSSs) weighs 6,046 pounds while the SSS configuration (three SSS shelters) weighs only 3,669 pounds. The subtotal for the existing TEMPER configuration (one ESC and two TEMPER tents) weighs 6,700 pounds.

The total configuration weights, with appropriate numbers of ECUs, are also provided in the table to facilitate total shipping weight comparisons. Note that the ASSTC has an integral ECU that is included in the shelter weight for that unit.

MOE 2-2: *Shipping volumes of each of the three shelter configurations*.

As with the shipping weights in the previous MOE, the SSS also has the least volume of the three configurations and the TEMPER/ESC the largest. Again, the volumes displayed in Table 2 provide subtotals for the shelters themselves and totals that include appropriate numbers of ECUs.

MOE 2-3: *Pallet space required to ship each of the three shelter configurations*.

Table 2 shows that, although the ASSTC configuration requires only one “equivalent” pallet space (PS), the dimensions of the ASSTC itself are such that it cannot be shipped on the same pallet with the two SSS shelters and the ECUs (see Figure 23). Nevertheless, the vacant space (volume) remaining on pallets number one and two, plus the vacant pallet number three, totals two “equivalent” pallet spaces. Those two “equivalent pallet spaces” are available for other EMEDS shipping requirements. Not also that the ASSTC overhangs the eight-foot pallet by 12 inches, which may present difficulties for some loaders and for developing “standard” pallet loads.

Table 2. Summary Comparisons – Configuration Weight, Volume, and Pallet Space (PS)

	ASSTC Configuration	SSS Configuration	TEMPER/ESC Configuration
Weight			
Shelters Only	6,046 lbs.	3,669 lbs.	6,700 lbs.
Configuration Total	7,268 lbs.	5,502 lbs.	9,460 lbs.
Volume			
Shelters Only	412 cu. ft.	243 cu. ft.	1,077 cu. ft.
Configuration Total	492 cu. ft.	363 cu. ft.	1,269 cu. ft.
Pallet Space			
Shelters Only	5/6 PP	1/2 PP	2 PP
Configuration Total	1 PS	3/4 PS	2 1/3 PS (plus 240 cu. ft. of internal

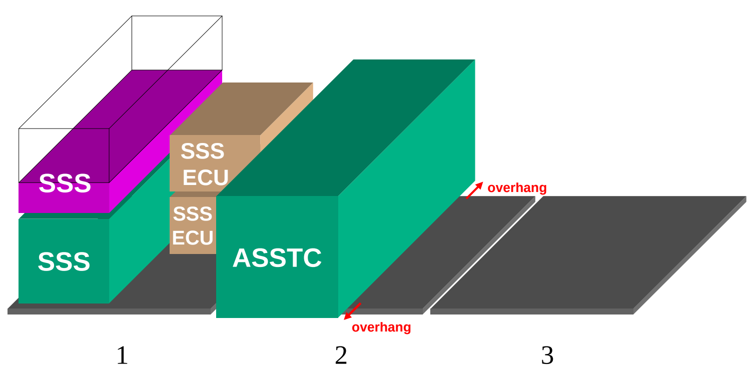


Figure 23. Pallet loading for the ASSTC configuration.

The SSS configuration (see Figure 24) requires only ¾ pallet space, leaving 2 ¼ pallets for shipping medical equipment and supplies required by the EMEDS team.

Table 2 shows that the ESC configuration requires 2 1/3 pallets. Note in Figure 25 that the ESC does not fit on a pallet as it measures 13'4" long by 8' wide by 8' high. Therefore, its size is estimated at "two equivalent" pallet spaces, plus the space required for three -39 ECUs (approximately 1/3 pallet). The two TEMPER tents for this configuration also exceed the size of a pallet (they are each 8'6" long). However, as shown in Figure 25, the TEMPER tents can be placed inside the ESC for shipping and still leave ½ pallet space equivalent inside the ESC for other EMEDS equipment and supplies.

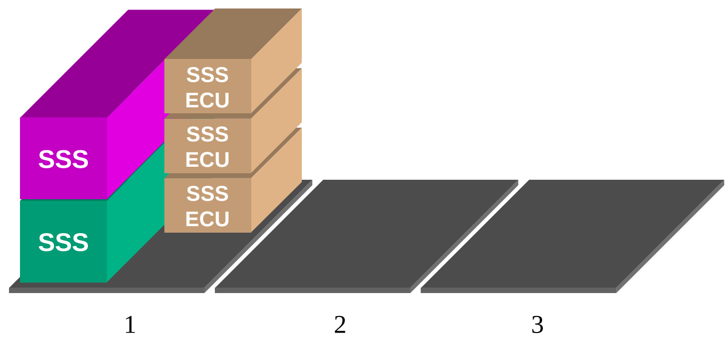


Figure 24. Pallet loading for the SSS configuration.

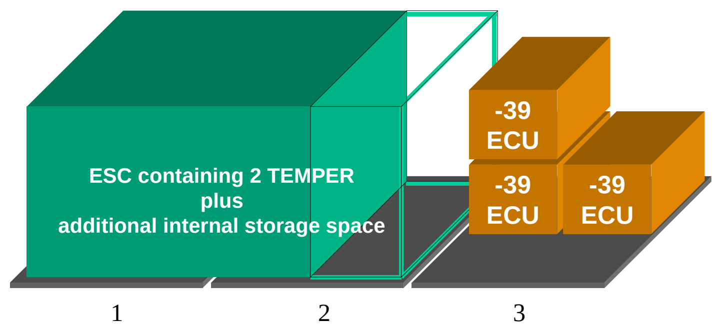


Figure 25. Pallet loading for the TEMPER/ESC configuration.

The ESC also requires a Flat Bed "K-Loader" to extract it from the aircraft, and it may require a 13K forklift if the loaded shelter weight exceeds the capacity of a 10K forklift. These requirements must be considered for potential bare-base operations where the Tactical Airlift Control Elements (TALCE) may not have adequate offload equipment available.

Footprint Summary

The SSS configuration best meets the reduced footprint goals of the EMEDS. By requiring only ¾ pallet space, the SSS leaves ample room (2 ¼ pallets) for shipment of medical equipment and supplies required for the EMEDS mission. Note, however, that although the SSS shelter weighs less and takes up less volume and pallet space, the tent does not come with a surgical room, surgical table, surgical lighting, and trays for medical supplies/surgical instruments, as does the ASSTC. When configured with these required items, the figures for the SSS should be recalculated.

Objective 3: *Identify and compare estimated component cost and additional cost factors associated with the ASSTC, SSS, and TEMPER/ESC shelter configurations.*

Measures of Effectiveness (Obj - 3)

MOE 3-1: *Purchase cost for each of the three equivalent shelter configurations.*

Table 3 provides a comparison of the purchase costs for each of the three shelter configurations. Subtotal costs are provided for the shelters only, and total costs include shipping containers, repair kits, cold weather packages, and ECUs, as applicable.

In order to objectively compare the SSS shelter to a corresponding ASSTC shelter, the SSS requires a surgical table, surgical lighting, and storage cabinets for surgical instruments and supplies. Note that the current TEMPER/ESC combination also requires additional equipment. These are additional costs for equipment that is already included in the ASSTC surgical suite.

Nevertheless, the ASSTC purchase cost is considerably greater than either the SSS or TEMPER/ESC configurations by factors of 2.8 and 2.6, respectively.

MOE 3-2: *Shipping cost for each of the three equivalent shelter configurations.*

The AEF Battlelab estimates the round trip shipping cost for one pallet to Southwest Asia as $14,200. Based on that estimate, the shipping costs depicted in Table 4 for either the ASSTC configuration or the SSS configuration are very similar (within $3,500).

Either of these two configurations requires less pallet space (and thus shipping cost) than does the current TEMPER/ESC shelter configuration. That configuration requires two pallets for the ESC and tents, plus another 1/3 pallet for ECUs, for a total of approximately 2 1/3 pallets at a shipping cost of $33,129. That round trip shipping cost to Southwest Asia is $18,929 greater than the ASSTC and $22,479 greater than the SSS configurations.

MOE 3-3: *Other cost factors for each of the three equivalent shelter configurations.*

The medical team provided several suggestions for modifications to the shelters, particularly the SSS tent. Those recommendations to make the shelter more usable for the required EMEDS functions will have costs that are not yet specified. The recommendations for improvements are listed in the final section and in Annex I of this *CATH Assessment Final Report*.

Other Cost Factors

Additionally, chemical/biological protection capabilities should be provided for the shelter configuration selected for the EMEDS. Providing such protection will result in additional costs that are yet to be determined.

Table 3. Configuration Purchase Cost Comparisons

	ASSTC Configuration		SSS Configuration		TEMPER/ESC Configuration	
	1 x ASSTC	$162,000	1 x SSS	$14,204	1 x ESC	$57,233
	1 x SSS	$14,204	1 x SSS	$14,204	1 x TEMPER	$7,100
	1 x SSS	$14,204	1 x SSS	$14,204	1 x TEMPER	$7,100
Sub Total		**$190,408**		**$42,612**		**$71,433**
	2 x SSS shipping box	$3,656	2 x SSS shipping box	$3,656		
	2 x SSS Repair Kits	$520	3 x SSS Repair Kits	$780		
	2 x ECU	$19,872	3 x ECU	$29,808	3 x ECU (-39s)	$ 12,750
Total		**$214,456**		**$76,856**		**$84,183**
	NOTE: None of the configurations includes MRSP in totals.					

Table 4. Configuration Shipping Cost Comparisons

	ASSTC Configuration	SSS Configuration	TEMPER/ESC Configuration
Shipping Cost			
Per Pallet	$14,200	$14,200	$14,200
	x 1 PP	x 3/4 PP	x 2 1/3PP
Total	**$14,200**	**$10,650**	**$33,129**

Objective 4: *Determine and compare the operational utility of the ASSTC and SSS shelter configurations to provide a ready-to-operate EMEDS capability in a reduced timeframe, the ability to sustain EMEDS operations, and the ability to redeploy/reconstitute.*

Measures of Effectiveness (Obj - 4)

MOE 4-1: *Time required to erect the shelters and declare ready for emergency (EM) operations.*

Figure 26. Erecting the ASSTC shelter.

ASSTC Erection: A timing of the assembly of the ASSTC was conducted on the morning of 4 February (see Figure 26). This was only the second time the eight-person EMEDS crew had erected the ASSTC, the first time being used for instruction and training. The total assembly time was 36-½ minutes. This time included assembly and setup for a "surgery ready" configuration as determined by the lead surgeon. Experienced United States Marine Corps (USMC) teams normally erect the ASSTC shelter in 18 minutes. The environmental conditions during setup were as follows: cloudy, temperature (ºF) in the mid-50s, with light winds.

Erection of the ASSTC shelter requires a minimum of four people on the eight-man team to be six feet in height with significant upper body strength, and most erection activities require a coordinated effort. Safety-related comments addressed lifting of the tent assembly above the box and potential pinching injuries during assembly of the ribs.

Numerous problems were encountered because of broken and worn equipment—the one-of-a-kind prototype ASSTC shelter had already been erected three times more often than its design limit. Other than these comments, the EMEDS crew and observers were favorably impressed with the efficient packaging and assembly design features incorporated in the ASSTC.

SSS Erection: On 1 February, an eight-person EMEDS crew erected the first SSS shelter in 50 minutes (see Figure 27). An additional 19 minutes were required to install the interior lining and electrical work, for a total time of 69 minutes. The completion time for setup of all three SSS shelters was four hours and 18 minutes (note that the second and third SSSs were erected by less experienced eight-person crews). Note also that an eight-person crew was used for erection of the SSS for equivalency to the crew size required for erection of the ASSTC; in reality the crew size would be based on availability of personnel.

The environmental conditions during setup were as follows: clear, temperature (ºF) in the mid-50s, with winds of approximately 12 knots.

Operators provided general comments and suggestions regarding SSS setup. Two types if liners were shipped in the SSS kits; the preferred one was a single piece that fitted over the horizontal bars connecting the ribs. In addition to being easier and quicker to install, it left the

Figure 27. Erecting the SSS shelter framework.

structural members exposed and thus readily available for hanging equipment. The other liner consisted of separate pieces for each shelter section and had to be velcroed to the ribs and each other to form a continuous inner liner. This process was difficult and time consuming.

Another comment was that pull straps were needed to help pull the end pieces over the frame. Safety concerns were: 1) the use of ladders (as can be seen in Figure 27) on an uneven surface needed to install the top horizontal bars connecting the ribs, 2) the horizontal bars can fall during installation and cause injury, and 3) the ribs are spring loaded into position and could slip.

In general, assembly and erection procedures were easy to learn and implement. Complete recommendations for shelter improvements are listed in the final section of this report.

MOE 4-2: *Identify any interface issues that affect employment of the shelter configurations (e.g., electrical, power, generators, water, or ground handling equipment).*

An interface problem identified by EMEDS personnel was in the use of a TEMPER tent section to serve as a vestibule attaching the three SSSs and the ASSTC. This was an ad hoc "fix" that would not provide an adequate fit if weather conditions had included blowing sand, dust, or snow.

ASSTC: The EMEDS team noted that the ASSTC ECU, while small, light, and very capable, is not in the Air Force inventory. Also, the ECU power connection is not Air Force standard.

SSS: The team noted that the SSS power distribution system, which is designed for use in a shelter used for personnel billeting, is not adequate for EMEDS needs in terms of the number and positioning of outlets.

MOE 4-3: *Ability of the configurations to sustain EMEDS operations and to be reconfigured for other EMEDS missions*.

Participants felt that the SSS (see Figure 28) offered better potential than the ASSTC configuration to meet this EMEDS requirement.

ASSTC: Team dissatisfaction centered on the placement of the surgical "box" in the center of the shelter, thus complicating traffic flow and efficient care of multiple patients (see Objective 1 results).

SSS: As configured for the F-4 Assessment, the only "unique" configuration difference in the three SSSs was the end section placed in SSS #3 for surgical suite isolation and a flap placed on the end of SSS #2 to provide cover for the instrument sterilization process. The EMEDS team considered these and other shelter configuration options as relatively easy to implement.

MOE 4-4: *Ability to tear down and reconstitute.*

ASSTC: A timed tear-down (disassembly) of the ASSTC was conducted on the morning of 4 February. An eight-person crew tore down the shelter in 1 hour 10 minutes. The environmental conditions during tear-down were not adverse factors (cloudy, light winds, and a temperature (°F) in the mid-50s). The crew encountered no problems.

SSS: On 5 February, the tear-down of the SSS took 1 hour 44 minutes. This time included repacking all shelter equipment into the shipping container. No problems were encountered other than difficulties in pulling stakes with the tool provided.

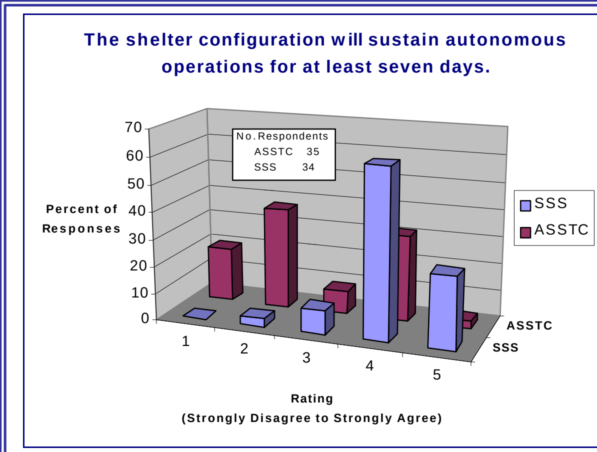


Figure 28. EMEDS personnel generally agreed that the SSS would support sustained operations.

Objective 5: *Determine and compare the operational environmental control factors of the ASSTC and SSS shelter configurations.*

The weather conditions during the CATH demonstration were not severe enough to truly assess environmental factors. Winds were light and not a factor most of the time, there was no significant blowing sand or dust, temperatures ranged from the 40s to the 60s, and only a light rain was experienced one night during the week's deployment. Annex H contains summaries of the measured environmental data.

Measures of Effectiveness (Obj - 5)

MOE 5-1: *Ability of shelter configurations to maintain a suitable temperature range for medical procedures*.

The ECUs maintained temperatures at a comfortable level for most of the participants, although the ASSTC measurements showed some differences between the inside and the outside of the surgical "box." Observers noted that on two occasions when EMEDS team members in the ASSTC requested a temperature change, an ECU adjustment provided quick results.

MOE 5-2: *Ability of shelter configurations to maintain suitable humidity levels for medical procedures*.

Humidity levels presented no problems.

MOE 5-3: *Ability of shelter configurations to sustain adequate illumination levels for medical procedures*.

Light levels were measured twice daily (see Table 5).

ASSTC. The levels in the periphery areas of the ASSTC were considered inadequate by participants, while levels in the ASSTC surgical suite were considered very good.

SSS. The bare-bulb incandescent lights that came with the SSS (used in SSS #3) were not adequate for EMEDS use. They could not be turned on/off one at a time, and they were not considered bright enough. The TEMPER tent fluorescent tube light used in SSS #1 and #2 were preferred.

Table 5. Average Measured Light Levels (lumens)

	Noon	0700
SSS		
Near Front Entrance	173.3	23.3
Center/Rear	28.7	14.2
ASSTC		
OR	188.8	159.0
Periphery	7.7	7.5

MOE 5-4: *Ability of shelter configurations to sustain adequate noise suppression levels for medical procedures*.

In general, noise did not present a problem to EMEDS team members. One team member had a single problem with aircraft noise during surgical procedures conducted in SSS #3. In addition, surgical team members expressed concern about the constant background noise from the ECU sitting just outside and feeding through the OR in SSS #3.

MOE 5-5: *Ability of shelter configurations to provide a physical barrier to the outside environment to prevent infiltration of dirt, sand, water, and insects into the interior*.

Sand and dirt did not migrate into the shelters except as tracked in by participants. Although wind was not a factor during the assessment, the design of both the ASSTC and SSS should preclude integrity problems experienced with TEMPER tents in the past (see Figure 29). When this factor was compared to the current TEMPER tent, the participants generally felt that both offered a significant advantage over the TEMPER.

MOE 5-6: *Ability of the shelter configuration ECUs to adequately filter particulates, such as sand, dust, and pollens, to a level compatible with safe medical operations*.

Particulate levels did not present a noticeable problem to EMEDS personnel. However, measured levels were higher inside both shelters than outside. Dirt tracked in was continuously stirred up by foot traffic until it was removed. Sweeping was made difficult by the very uneven canvas flooring.

Chemical/Biological Protection Considerations

A factor related to the ability of the shelters to protect inhabitants is their ability to provide protection during possible chemical/biological attacks. Although this aspect of the shelters was not examined during the CATH assessment, the following discussion and considerations apply.

The current *Draft Concept of Operational (CONOPS) for EMEDS and Air Force Theater Hospitalization (AFTH)* does not reflect requirements to provide chemical/biological protection for the EMEDS, other than personal protection gear for personnel. Nevertheless, the realities of today's threat environment require consideration of capabilities to enable our forces to survive and operate in areas where chemical/biological agents may be present. This reality is especially applicable for expeditionary forces. Therefore, shelters selected for EMEDS operations should either have such chemical/biological protection or be able to be easily modified or retrofitted to provide it.

Figure 29. Snow and dirt drifted into the TEMPER tent during winter deployment.

At present, neither the ASSTC nor SSS shelter configuration is equipped to provide chemical/biological protection for the medical function. The ASSTC has a barrier wall configuration designed to accommodate chemical/biological protection, but it has not been tested. Basic experiments to examine approaches to chemical biological protection for the SSS were conducted using an inflatable insert, but again, no actual capability exists. Capabilities applicable to SSS billeting replacements for the TEMPER tent are also under development through the USAF Joint Collective Protection System (JTCOPS). Under JTCOPS, systems like the Chemically Hardened Air Management Plant (CHAMP) developed for the Chemically Hardened Air Transportable Hospital (CHATH) may be adaptable for EMEDS requirements. However, JTCOPS technologies will probably not be available until FY06 or beyond. Improvement for the SSS shelter should address the requirement for a chemical/biological protection retrofitting capability.

Overview

The EMEDS team deployment to the F-4 Assessment provided valuable insights directly applicable to decisions regarding future Air Force EMEDS shelter acquisitions.

The medical team operators were very impressed with the SSS regarding its ability to support all EMEDS functions. Additionally, the SSS requires only three-quarters of one pallet position for shipping. Therefore it meets the reduced pallet size goal of the EMEDS shelter selection criteria and leaves two and one-quarter pallets for shipping other essential EMEDS medical equipment and supplies. The medical operators did identify improvements for the SSS, but they are not extensive. These improvements should be implemented to enhance the system's capabilities regarding patient flow, environmental control, storage, and an enclosed surgical suite. The operator-identified improvements are listed at the conclusion of this section.

The consensus of the medical team operators is that the ASSTC shelter is not satisfactory for USAF EMEDS functional requirements as currently configured. The primary operator concerns were the cramped space of the ASSTC surgical suite and the fact that the suite "box" was in the center of a circular shelter, therefore making patient flow and care very difficult. Positive aspects of the ASSTC noted by operators included the excellent lighting in the surgical suite, the surgical table design, and the adequate airflow through the surgical suite.

The assessment indicated that ***the ASSTC should not be the shelter of choice for the Air Force***. This conclusion is based on the fact that the ASSTC requires significant modifications in order to fulfill Air Force EMEDS requirements and that making such modifications may not be cost-effective or timely. Additionally, the ASSTC configuration requires more pallet space than the SSS configuration, therefore leaving less space for shipment of other essential EMEDS medical equipment and supplies.

This conclusion is further supported by the fact that the SSS configuration, with minor modifications identified by the EMEDS team, can provide a near-term capability that meets the medical functional requirements of EMEDS while also meeting the reduced pallet size and footprint requirements necessary for AEF operations.

Recommendations

Pursue further development of the SSS configuration for medical operations as the AEF EMEDS shelter system, incorporating the modifications enumerated below.

These recommendations are a result of data collected and input gathered from participants and observers during the F-4 exercise. Further amplification of selected recommendations can be found in the After Action Reports in Annex I. Decisions to incorporate recommendations should consider impacts on total weight and pallet requirements.

Structure Recommendations

- Provide a separate, sealable surgical suite area with lighting, a surgical table, and storage.
- Provide the surgery suite area of the shelter with conditioned airflow separated from the rest of the shelter area in order to keep the surgery suite area as clean as possible.
- Provide an improved floor that is easy to clean, does not easily puncture, provides good seals from outside contaminants and insects, and facilitates rolling and moving medical instruments, carts, and storage bins. Research the availability of

lightweight composite flooring (e.g., the modular Personnel Flooring System (PFS) developed by AAR Cadillac Manufacturing) that could be laid under existing fabric flooring to help meet these requirements. Another potential fix would be plywood flooring laid on the ground prior to layout of the tent frame/floor. This flooring requirement is particularly acute for the operating room.

- Provide an improved door system for the shelter. Such doors should be hard (rather than fabric), should swing both ways, and should be at least four feet wide to accommodate litter patient transport.
- Improve the lighting throughout the shelter – especially for the surgical area. Improvements should consider using the types of lighting found in the ASSTC surgical suite and the fluorescent lighting found in the TEMPER tent.
- Provide an ability to hang items, such as IVs and other medical equipment, from interior supports.
- Eliminate the fabric "tripping hazard" at the bottom of the doorways – or provide a bridging arrangement to accommodate litter transport. The bottoms of the door frames could be fabricated from flat stock material to minimize tripping hazards.

Environmental Recommendations

- Provide a better fit for ECU plenums.
- Provide an airtight fit between wards and the operating room.
- Provide a better way to keep dust/dirt from being tracked into the shelter.
- Consider means to provide chemical/ biological protection for the selected EMEDS shelter, if such does not exist.

Power Recommendations

- The SSS's power package should be compatible with the existing AEF deployment power and power connections. The power package should also consider locations, numbers, and capacities of power outlets required for the medical mission rather than for the billeting function for which the SSS was originally designed.

General Recommendations

- Provide storage cabinets and shelving.
- Provide a better method to extract tent stakes.
- Make the shelter package "forkliftable." The current plastic boxes for the SSS are not constructed to be lifted by a forklift.
- Provide a built in "inter-tent" connection (vestibule).

ANNEX A – ACRONYMS AND ABBREVIATIONS

ACC	Air Combat Command
ACC/SG	Air Combat Command Surgeon General's Office
ADVON	Advanced Operation
AEF	Air Expeditionary Force
AEFB	Air Expeditionary Force Battlelab
AFMS	Air Force Medical Service
AFOTEC	Air Force Operational Test and Evaluation Center
AFTH	Air Force Theater Hospitalization
ASSTC	Advanced Surgical Suite for Trauma Casualties
ATH	Air Transportable Hospital
CATH	Compact Air Transportable Hospital
CONOPS	Concept of Operations
Det 1	Detachment 1 AFOTEC
DoD	Department of Defense
DT&E	Developmental Test & Evaluation
ECU	Environmental Control Unit
ED	Execution Document (ED)
EM	Emergency
EMEDS	Expeditionary Medical Support
ESC	Expandable Shelter/Container
F-4	Form, Fit, and Function Follow-on
HSEP	Hospital Surgical Expansion Package
HVAC	Heating, Ventilating, and Air Conditioning
IFE	In-Flight Emergency
IOT&E	Initial Operational Test & Evaluation
IV	Intravenous
ISO	Industrial Standards Organization
KBI	Kenney Battlelab Initiative
MFST	Mobile Field Surgical Team
MOE	Measure of Effectiveness
MOOTW	Military Operations Other Than War
MRSP	Mobility Readiness Spares Package
NBC	Nuclear, Biological, Chemical
OR	Operating Room
ORD	Operational Requirements Document
SSS	Small Shelter System
TEMPER	Tent, Extendable, Modular, Personnel
USAF	United States Air Force
USMC	United States Marine Corps
UTC	Unit Type Code

ANNEX B – SYSTEMS DESCRIPTIONS

Small Shelter System (SSS)

The SSS Model FNSSS-HIT-2032.5 (see Figure B-1) is designed to provide protection for personnel, equipment, and supplies in all types of climate and terrain, including extreme cold and heat. The system can be used in any environment of bare-base missions with only normal organic support provided. The SSS is currently undergoing test and will shortly replace the current Air Force small shelters.

The SSS is engineered for durability, portability, and simplicity in both erection and tear-down. It is transportable in all modes of organic Air Force transport. It will be used primarily for billeting, but has the capability for numerous other missions, including command post, administration, messing, maintenance shops, and medical facilities.

Figure B-1. SSS shelters employed during the F-4 Assessment at Nellis AFB.

The SSS is designed to provide for extended erection of 10 years, with a shelf life of 20 years. The shelter is available in tan, green, or white for use in areas where the terrain is predominately those colors. The shelter can be used in all types of weather, such as snow, rain, hail, and wind, and on all types of terrain, such as desert sand or frozen tundra. It is designed to be set up in 35 minutes by a trained crew of four. The SSS contains a wiring harness that produces 600 watts of light at 120 volts and 60 Hz, and the receptacles are rated at 29 amps each.

Figure B-2. ECU shelter for SSS shelter being moved into position.

The SSS includes a 20’ wide x 32.5’ long x 10’ high free-span structure, the Environmental Control Unit (ECU) Model # HAC-36-V4A (see Figure B-2), Quick Connect Wiring Harness, and 463L palletable transport containers. The structure is a lightweight, aluminum frame system that tensions into a high strength aluminum base (see Figure B-3). The ECU attaches to the structure by means of expandable ducting, with no tools required. The structure is modular, supported by the aluminum frame, and covered with military specification vinyl fabric. Transportable containers are provided for the structure (see Figure B-4). Ruggedized vinyl bags contain top cover insulation batts and insulated floor pads. The bags are man-liftable.

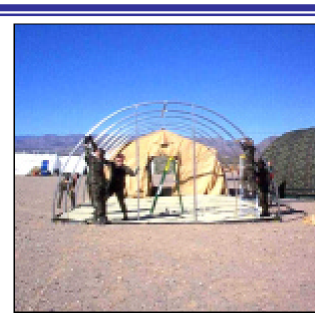


Figure B-3. Erecting SSS aluminum frame during Nellis AFB deployment.

Electrical power is provided by the Air Force Harvest Falcon Electrical System. This system provides adequate power to operate the ECU, shelter lighting, and electrical outlets. The wiring harness contains the following components:

- Four 150-watt polycarbonate light fixtures that require two 75-watt incandescent “A” type light bulbs.
- Four 120-volt duplex receptacles with weather-proof covers.

- One plastic distribution panel with one single-pole, 20-amp light and one single-pole, 20-amp GFCI breaker for receptacles. The distribution panel has color-coded cord ends for easy installation.
- One NEMA L5-20P cord end attached to the distribution panel for hookup to the power source.
- One 50', 20-amp power cable for attaching the distribution panel to the power source.
- A three-ton air conditioner and a 9-kW heating element to maintain interior shelter temperatures. Refer to the *ECU Tech Manual* for operation characteristics and parameters of the ECU. The wiring harness is rated for damp conditions. Operating parameters for SSS environmental thresholds are provided in Table B-1.

Figure B-4. Packing SSS components into transportable container.

Table B-1. Environmental Threshold Operating Parameters

INSIDE ENVIRONMENT	OUTSIDE AMBIENT TEMPERATURE
+80º F	at +125º F
+45º F	at –25º F

Advanced Surgical Suite for Trauma Casualties (ASSTC)

The collapsed ASSTC shipping container measures 5'4" wide x 4'6" tall x 10' long. It converts into a room that measures 12'8" wide x 7'11 ¾" tall x 10' long (see Figure B-5). The tent collapses into a bag and is carried in the collapsed ASSTC box. The tent, when deployed around the expanded structure, measures 30' 9" in diameter and is 13' tall (see Figure B-6). It is an excellent insulation system with built-in dead air spaces and is made to operate from -20 degrees F to +120 degrees F.

Figure B-5. ASSTC shelter components being unloaded from box at start of assembly process.

The ASSTC tent and expanded structure are designed to withstand a six-foot snow load. Without tie-downs, the tent will withstand 30-knot constant and 60-knot gusty winds. It has 16 supporting poles (see Figure B-7) and is designed to function fully with as many as four poles missing or broken. This is accomplished by repositioning the remaining poles and adding external tie-downs where poles are missing or damaged. The tent fly contains layers of Saranex® to provide NBC resistance.

Figure B-6. Erected ASSTC at Nellis AFB with ECU in operation.

The ASSTC has a heating, ventilating, and air conditioning (HVAC) system for environmental control and can be connected to a positive pressure filter to continue NBC protection. The HVAC unit and NBC filter fit into the collapsed ASSTC box. Storage cabinets are accessible and changeable while the box is in the storage configuration. It takes about a minute to open the side doors and another two minutes to pull the cabinets out and replace them with restocked or reconfigured cabinets. It is possible, but certainly not necessary, to stock the individual drawers to resupply or reconfigure the ASSTC. Spare cabinet assemblies can be kept ready at a convenient location for this purpose.

When the ASSTC box is deployed, the cabinets are accessible from both inside and outside the surgery room (see Figure B-8). There are six cabinets. Each cabinet has five drawers: one three-inch deep drawer, two drawers that are six inches deep, and two that are nine inches deep. The drawers are 14 inches long by 18 inches wide. Drawer capacity per cabinet is 8,316 cubic inches. The total capacity of the six cabinets is 49,896 cubic inches.

Figure B-7. Poles attached to the ASSTC structure prior to erection during F-4 Assessment.

There is also a 25-gallon stainless steel water storage reservoir in the base of the ASSTC.

The standard ASSTC uses 15 kilowatts of electricity: 7.2 kW for air conditioning, 9 kW for heating, and 6 kW minimum for internal lighting and appliances. It is wired for 208-volt, three-phase, wye configuration to be compatible with military standard generators. Available voltages are 208 three-phase at the HVAC unit, with 110 and 220 single-phase available inside the ASSTC deployed box. The unit can run on either 50 or 60 cycles, although some efficiency is lost when operating on 50 cycles.

Figure B-8. Assembling cabinets in the ASSTC surgical suite.

The ASSTC box has numerous electrical outlets for internal lighting and appliances. Each of the two doorways has two electrical strips containing six outlets each. There are five-outlet electrical strips on the inside of each of the three cabinet support frames. The fourth frame contains a shelf for a medical monitor station and has a six-outlet strip built into it.

Six florescent tube lights similar to those used in the TEMPER tents provide general lighting for the ASSTC. Two additional 16-inch florescent fixtures are built into the roof of the surgery room. These two fixtures energize immediately with the application of power and provide internal setup lighting in dark conditions. There are two track light receptacles in the roof that have adjustable halogen spotlights.

Kenney Battlelab Initiative

Compact Air Transportable Hospital

Advanced Surgical Suite for Trauma Casualties
for
Expeditionary Medical Support

PROPOSED BY:

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Email: Don.Diesel@Mountainhome.af.mil

APPROVED BY:

WILLIAM A. PECK, JR
Brigadier General, USAF
Director of Requirements

1. **DEMONSTRATION MISSION STATEMENT:** Demonstrate the military utility of a compact, light weight deployable Advanced Surgical Suite for Trauma Casualties (ASSTC) to provide forward resuscitative surgical support for Air Expeditionary Force operations.

1.1. **Background:** Today's rapid deployment requirements demand a light, mobile medical platform able to support early management of trauma patients during attainment and initial phases of deployment. USAF/SG has requested that ACC/SG take the lead in development of next generation AEF Health Support and AF Theater Hospitalization CONOPS, to include development and test of Mission Capability Statements and Allowance Standards to support this capability. In turn, the 366th Medical Group has been appointed as a pilot unit for development of an Expeditionary Medical Support (EMEDS) package. The EMEDS will consist of a 24-member medical team and supplies equivalent to three full pallet positions. The package would support 1,500 deployed personnel and be capable of operating independent of host nation support. Deployment would occur with an Advon team of a flight surgeon and Independent Medical Duty Technician (IDMT), followed by a five-person Mobile Forward Area Surgical Team (MFAST) on the first transport with the remainder of the package (additional 17 persons and three pallets) within the next 24 hours. EMEDS capability will include primary care, resuscitative surgery, dental and intensive care, flight medicine, preventive medicine, and orthopedics. Two sites (hospital and flight line) would be provided along with 24-hour ER.

1.2. **Problem:** Current medical equipment packages cannot provide trauma and resuscitative surgery capability in a compact package and must be tailored for AEF operations. Previous AEF medical operations have used an available Expandable Tactical Shelter (two pallet positions) for a surgery suit. While this met the needs of the surgery team, it is larger than desired, limited in space, and requires extensive configuration time.

1.3. **Proposed Solution:** Incorporate the USMC-developed ASSTC technology within the EMEDS package.

1.4. **Concept of Operations:** The ASSTC system was developed to enable rapid deployment of battlefield resuscitative surgery and trauma care. The transport box is 5'x5'x10' (approx. ½ pallet position) and weighs 3,600 lbs. Approximately 1,000 lbs. of additional equipment can be carried internal. The system consists of one 10'x12' surgical suite, triage area, area for six patients, ECU providing positive pressure for NBC protection, lighting, and storage compartments. Setup time is under 30 minutes. Medical supplies/equipment are specifically selected to provide essential capabilities while minimizing the size of the package. Supplies can be tailored to the mission, for example emergency medical care for disaster relief or medical care in remote areas. Incorporating the ASSTC into the EMEDS package would establish urgent/emergent medical care early in the deployment and reduce the AEF medical logistics footprint.

1.5. **Time Required:** 6 months.

2. **COURSE OF ACTION**

2.1. **Strategy to Achieve:**

Step 1: Conduct basic requirements analysis, establish guidelines for AEF medical support and structure of EMEDS (AEF VII, Aug 98).

Step 2: Integrate the ASSTC into the EMEDS package.

Step 3: Conduct field evaluation under AEF deployment scenario. The Form, Fit, and Function Follow-on (F4) medical deployment exercise at Nellis AFB (February 1999) will be utilized to evaluate the ASSTC.

2.2. Methods of Measurement:

2.2.1. Military medical professionals with deployment experience will assess equipment suitability, capability, and compatibility. Previous deployment data will be used to compare mobility, setup time, and casualty care capability/suitability.

2.2.2. Cost data (including air transport) based on past exercises/operations that utilized existing medical UTCs (ATH) will be compared with the ASSTC system.

2.2.3. A field demonstration will be conducted during a major exercise/deployment to evaluate military utility and medical adequacy of the system. The small shelter manufactured by Alaska Industrial Resources, Inc. (TEMPER tent replacement) will be used to establish a "baseline" for comparison against the ASSTC. Surgical procedures will be conducted in both shelters using consenting patients and/or animals to validate the surgical suite and assess its advantages over the SSS shelter.

2.3. Schedule and Risk:

2.3.1. Integration of system with EMEDS: three months – low risk.

2.3.2. Demonstration preparation: two months – medium risk.

2.4. Resources Required to Execute Course of Action:

2.4.1. USMC will provide the second prototype of the ASSTC for outfitting with equipment and field evaluation by AEF Battlelab. USMC will also provide training on erecting the shelter and care/maintenance of the shelter. USAF will require the ASSTC on loan for three weeks to accomplish the evaluation. USMC will arrange for the shipment of the ASSTC to the evaluation site and 366th Medical Group will arrange return shipment, with AEFB paying for shipping costs

2.5. Funding Required: $204K

$20K TDY for coordination with supporting units

$5K Shipping cost for ASSTC

$147K Data collection, analysis, and reporting (Det 1)

$12K Materials & ODC

$20K TDY/Travel for Evaluation
- $10K AEFB
- $10K Det 1

2.6. Expertise Required:

2.6.1. AEF Compatibility: 366th Medical Group will assess the compatibility of the system with AEF operations and the mini-ATH package.

2.6.2. Medical Requirements: MFAST from Wilford-Hall Medical Center will determine whether system adequately meets medical requirements for trauma/surgical support.

2.6.3. Evaluation Support: Det1 and AFRL/HEP will provide human factors analysis and test/evaluation expertise.

2.7. Organizational Support:

2.7.1. HQ ACC will:

2.7.1.1. Assign an initiative sponsor.

2.7.1.2. Accomplish MAJCOM responsibilities in executing this initiative.

2.7.2. HQ ACC/SG has agreed to and will:

2.7.2.1. Transfer and secure necessary initiative supplies and equipment for outfitting the ASSTC and EMEDS package.

2.7.2.2. Coordinate with AEFB on concept demonstration support.

2.7.3. 366 Wing will:

2.7.3.1. Provide medical personnel to support the evaluation of the ASSTC in the field.

2.7.3.2. Assist in public affairs release.

2.7.3.3. Assist in graphic and photographic support for the initiative.

2.7.4. Wilford-Hall Medical Center (59 MDW) will:

2.7.4.1. Provide MFAST members as part of the EMEDS package to support the evaluation of the ASSTC for surgical capability.

2.7.5. AFRL/HEP will:

2.7.5.1. Assist with test and evaluation of the ASSTC with regard to medical functionality and provide human factors expertise.

2.7.6. Det 1 will:

2.7.6.1. Assist in refining/defining the assessment scenario, developing sample analytic products, and preparing the data execution document.

2.7.6.2. Collect and analyze data during predeployment preparations and during the F4 exercise at Nellis AFB. Provide quick look reports on site.

2.7.6.3. Provide a final report within 30 days of completion of the F4 exercise.

2.7.7. AEF Battlelab will:

2.7.7.1. Manage and conduct the overall demonstration.

2.7.7.2. Participate in the preparation of the After Initiative Reports.

2.7.7.3. Assist the test managers and contractors as necessary.

2.7.7.4. Designate an Initiative Manager.

3. AFTER INITIATIVE REPORT: May 1999

Distribution List

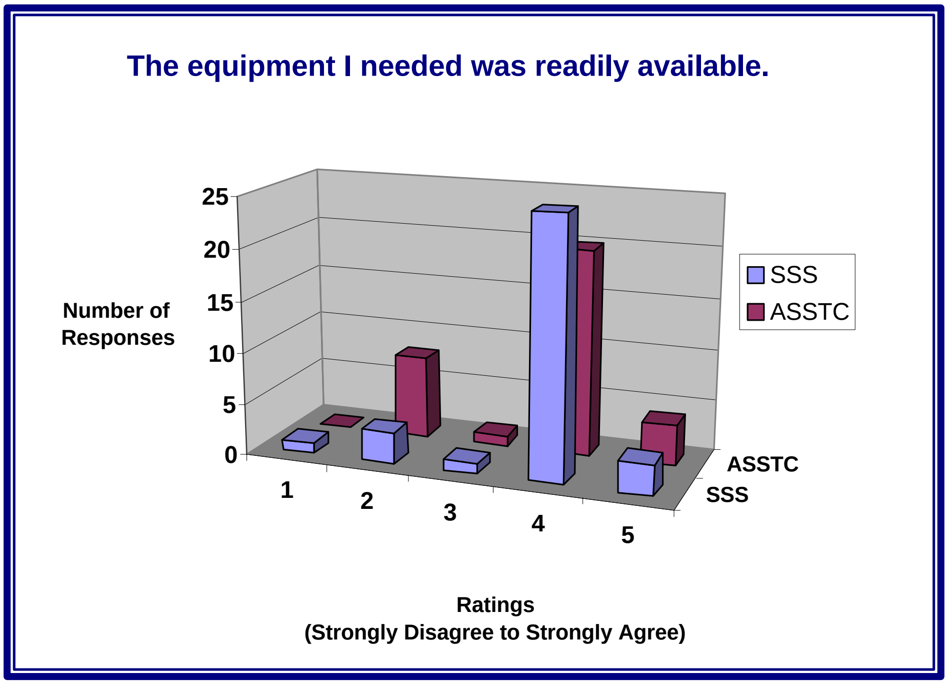
HQ ACC/DR
HQ ACC/DRM
HQ ACC/SG2
HQ ACC/SGOP
HQ USAF/SGXR
USMC Combat Development Command
HSC/YA
59 MDW/MMKG
Det 1
AFRL/HEP
HQ AFMC
366 MDG/CC
366 WG/CC

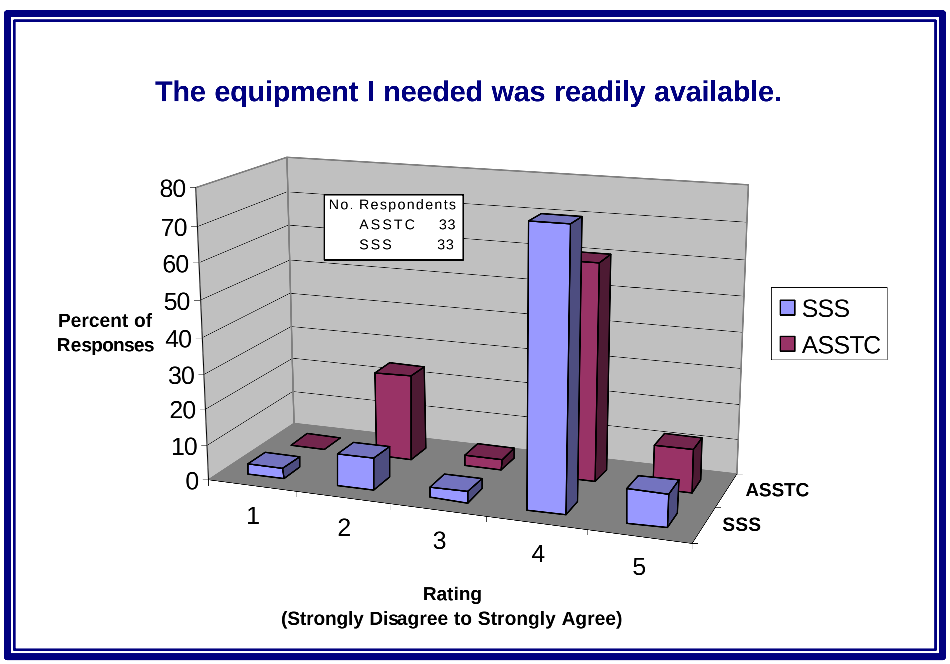
ANNEX D – FUNCTIONAL QUESTIONNAIRE RESULTS

This annex contains results in the form of histograms from ratings (“Strongly Disagree” to “Strongly Agree”) provided by EMEDS personnel on the *Medical Functionality During Typical Activities* questionnaire. Annex G contains the same type of information for shelter setup operations, and Annex E extracts information found in this annex for each function performed by the EMEDS personnel (MOE 1-1 through 1-9).

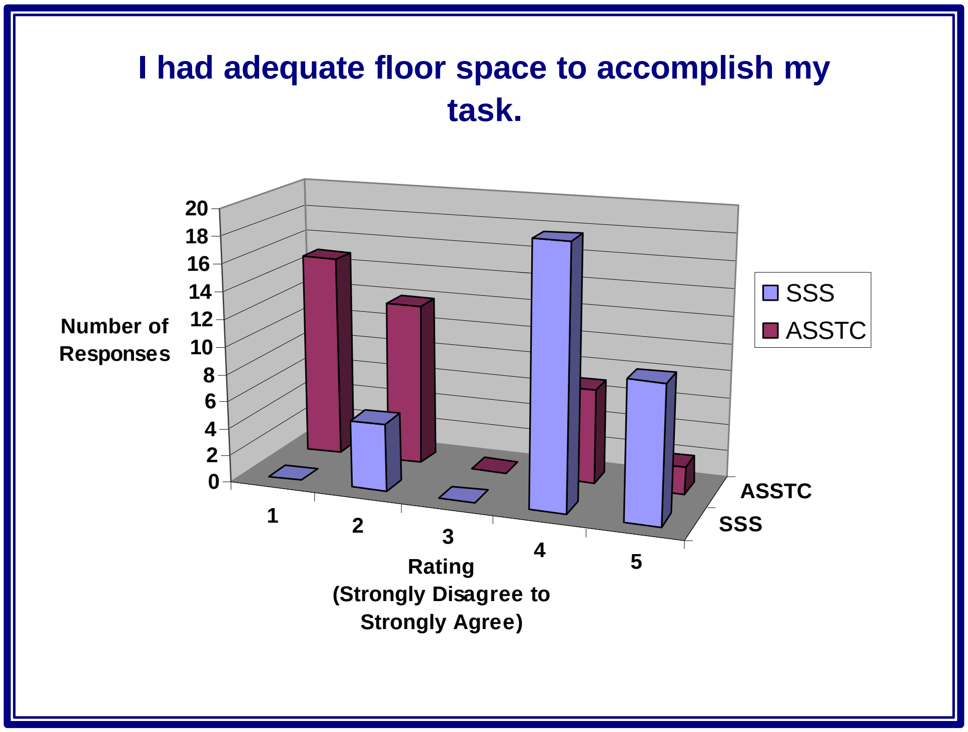
Two histograms are included for each question: the first depicts the number of responses recorded for each rating, and the second depicts the percentage of the total responses (by shelter configuration) recorded for each rating.

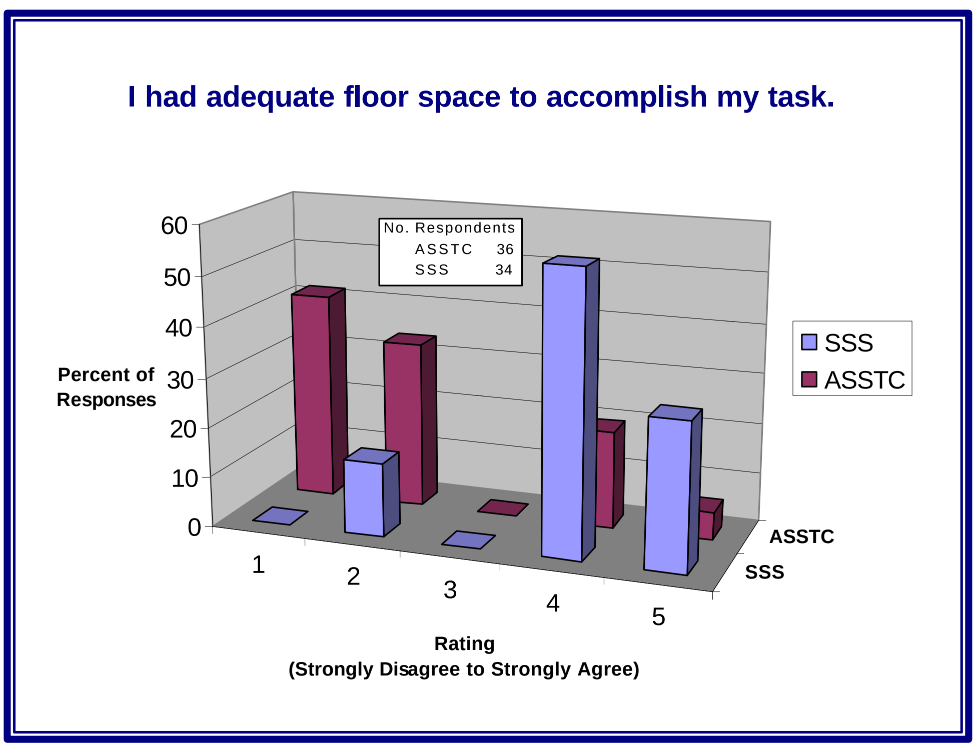
Functionality - Question 1



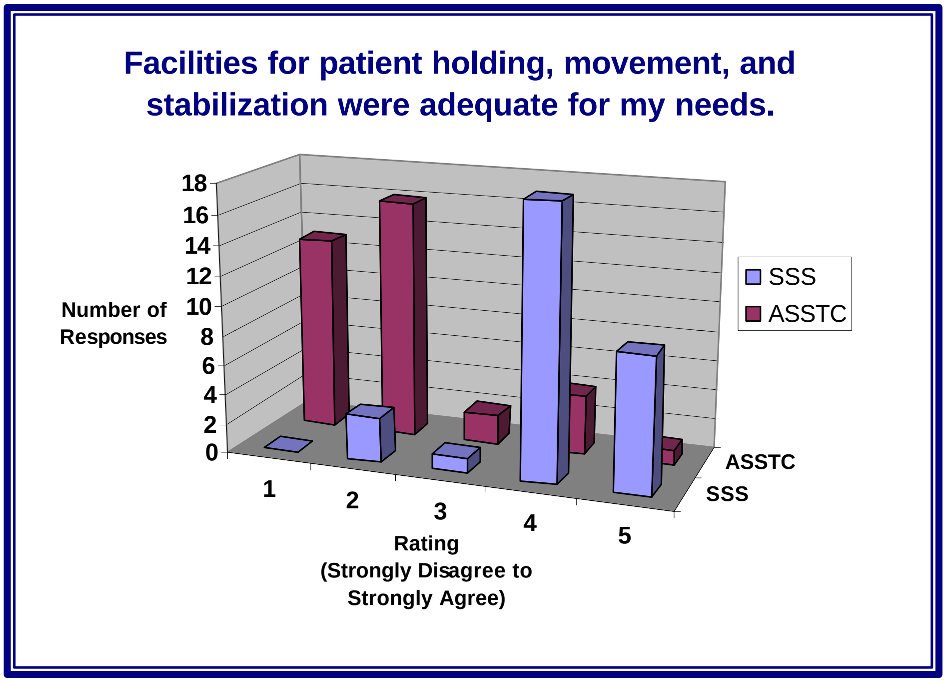


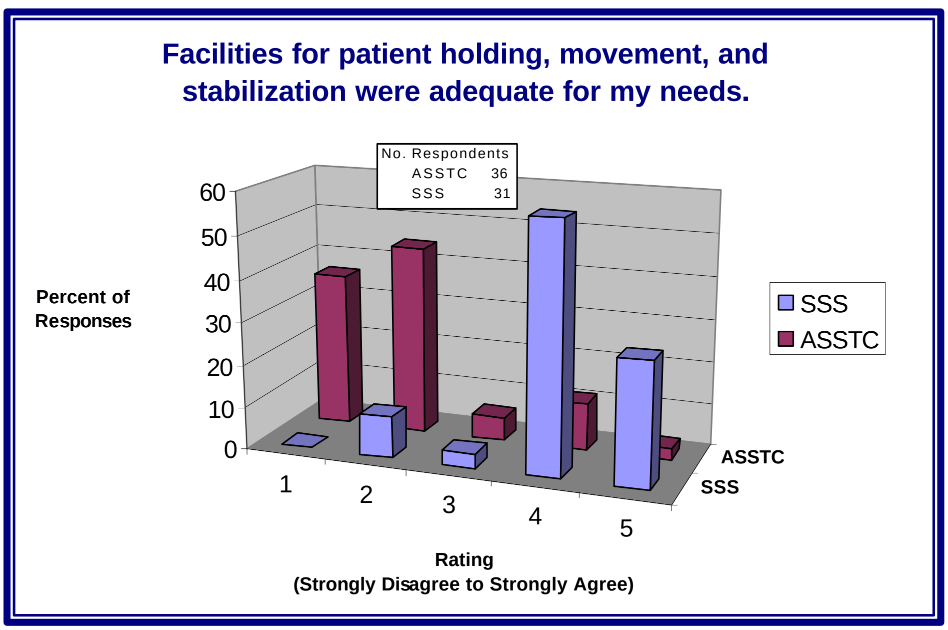
Functionality - Question 2



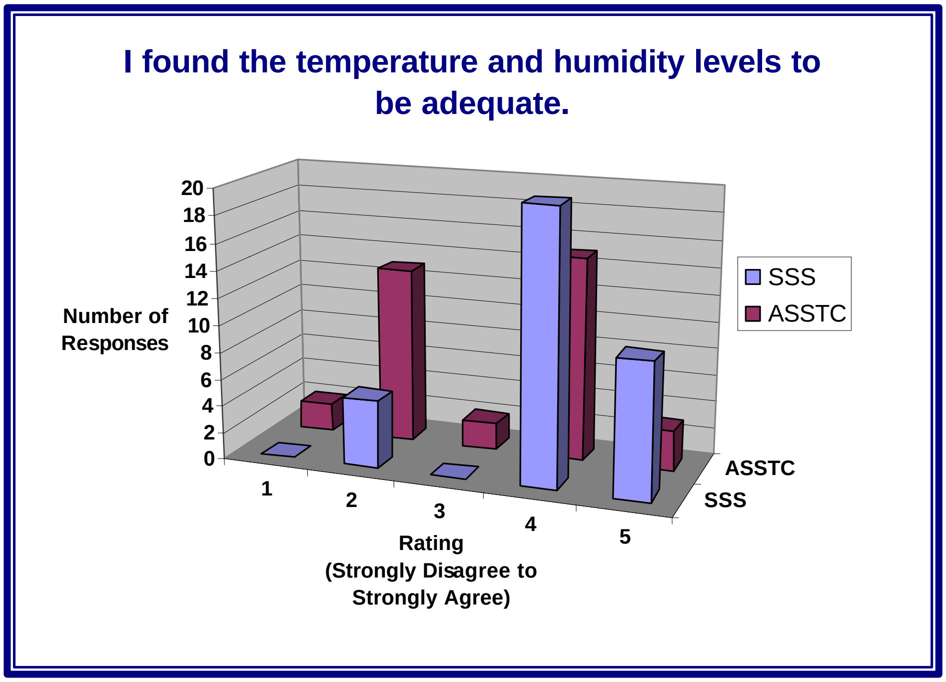


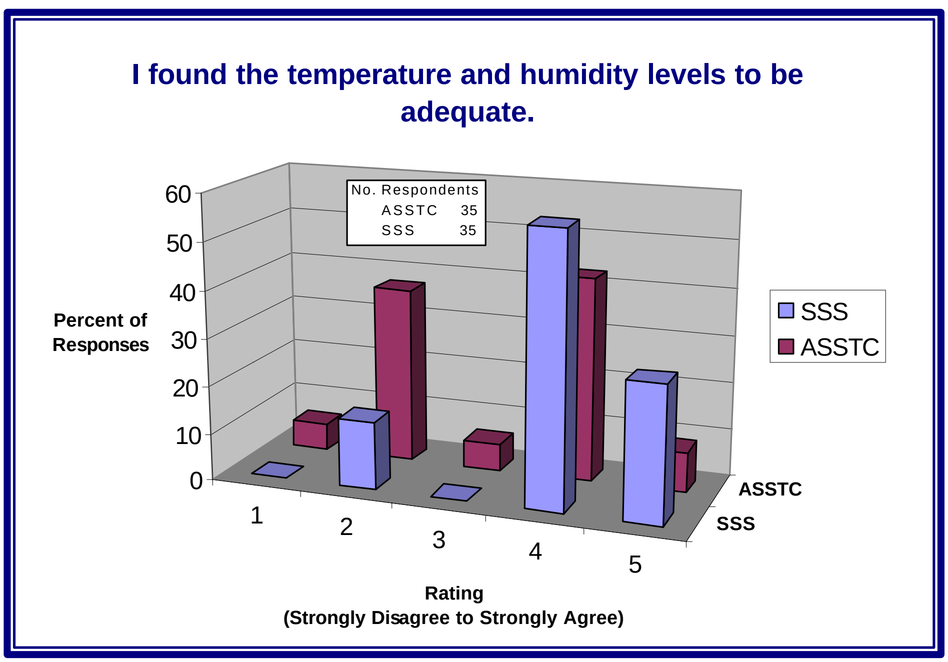
Functionality - Question 3



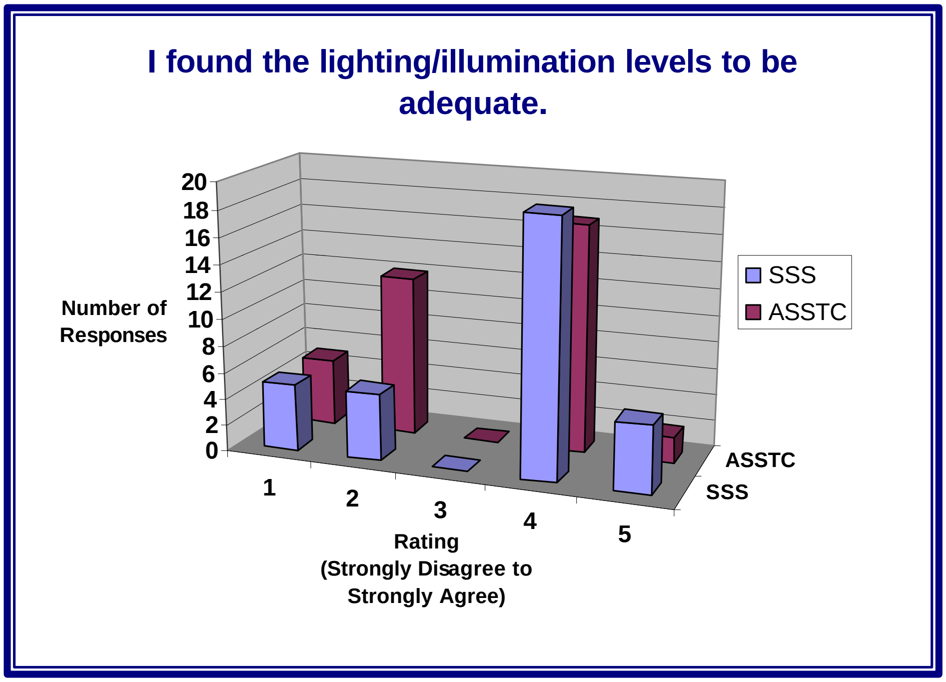


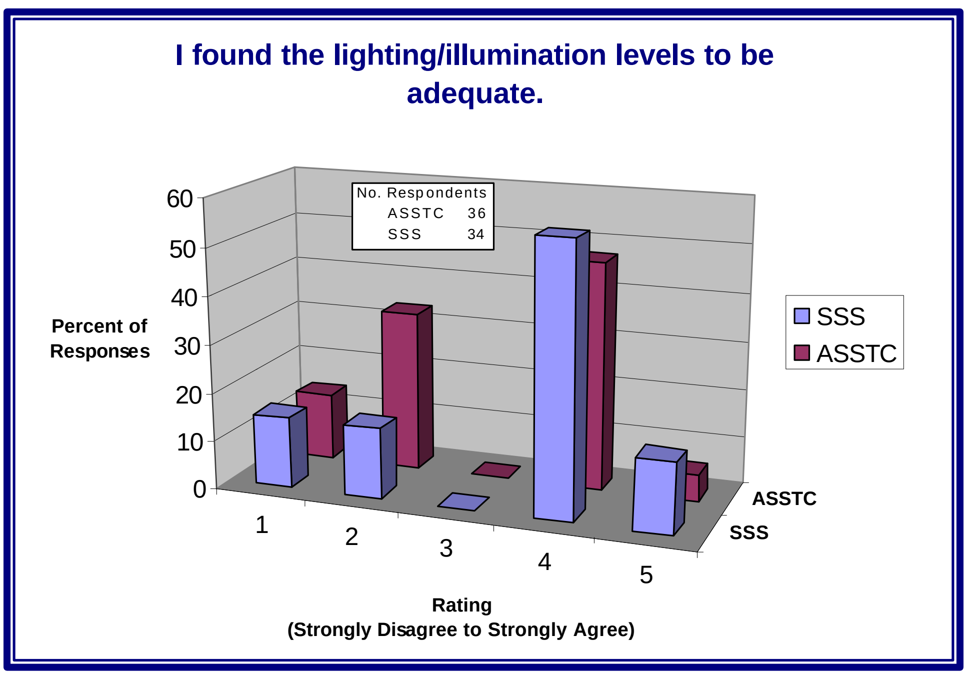
Functionality - Question 4



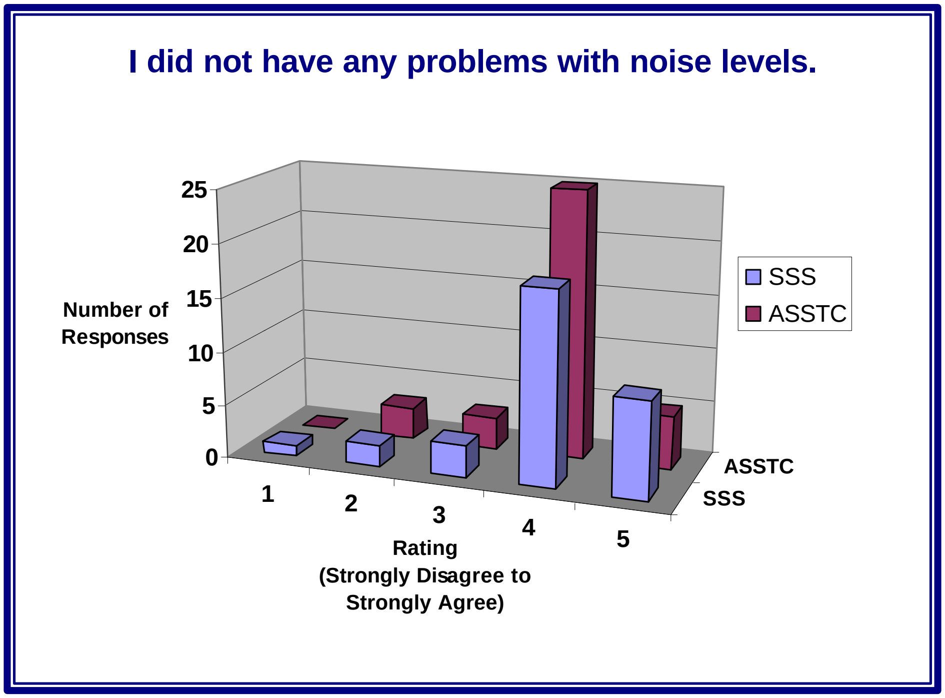


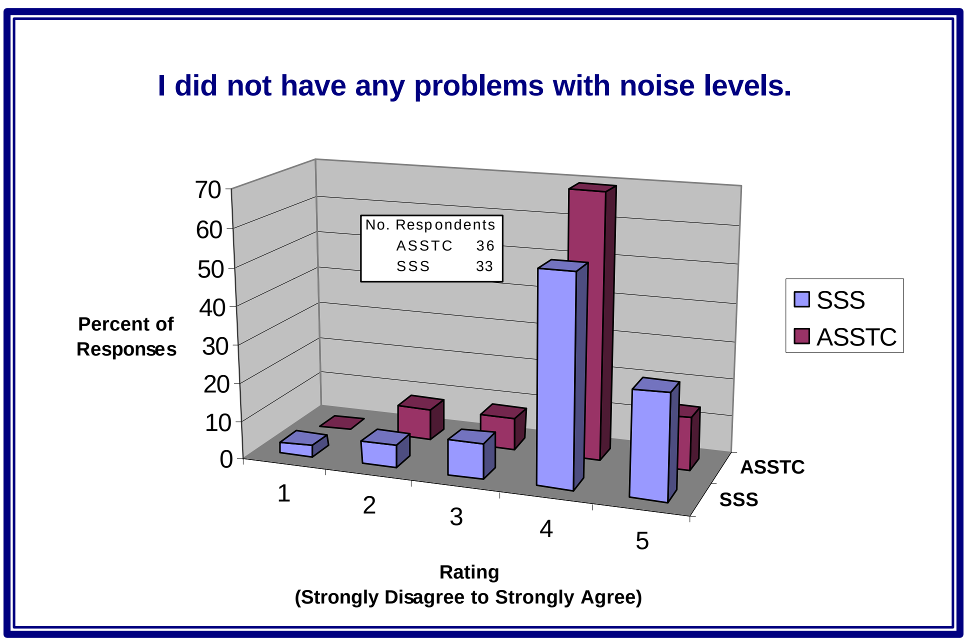
Functionality - Question 5



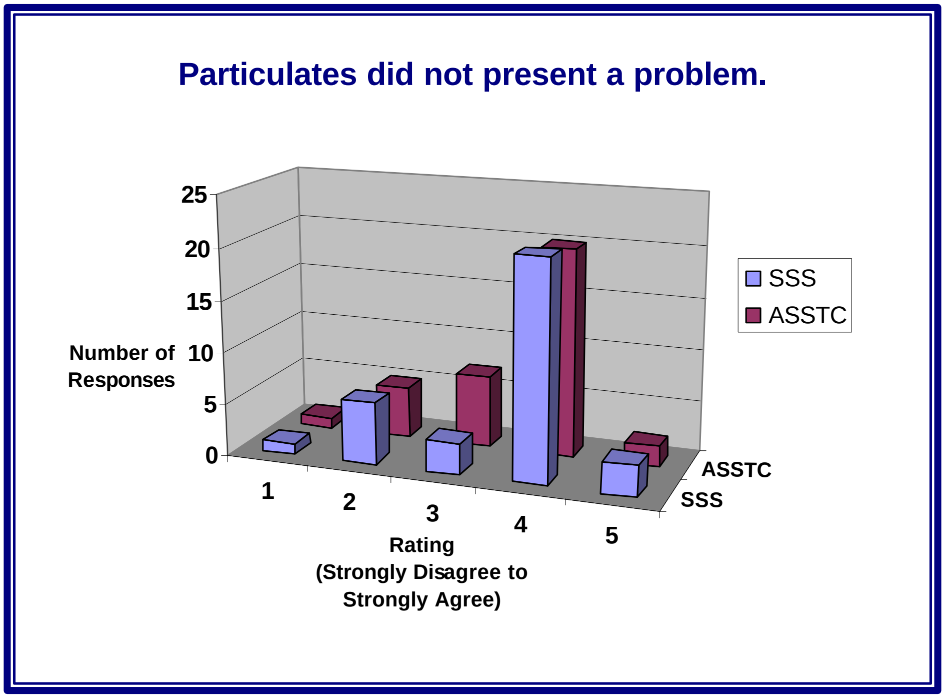


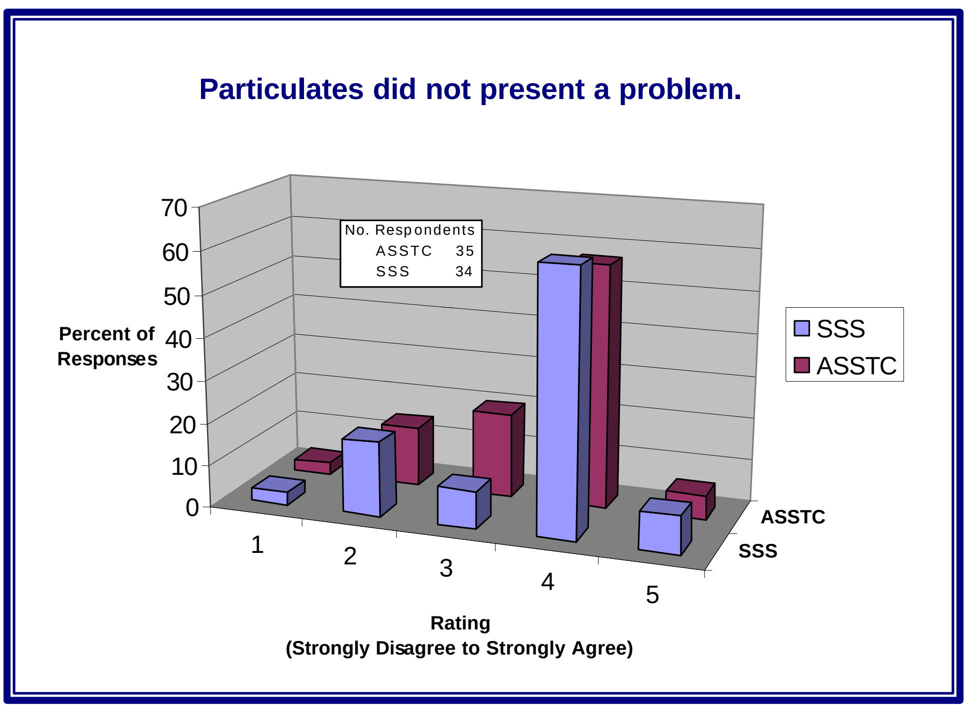
Functionality - Question 6



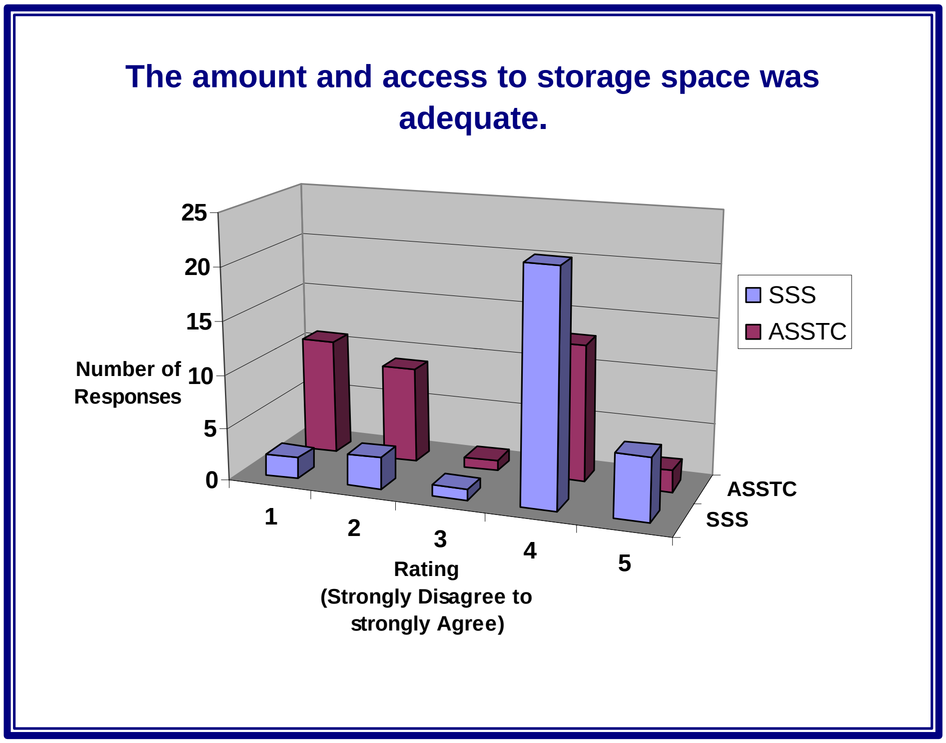


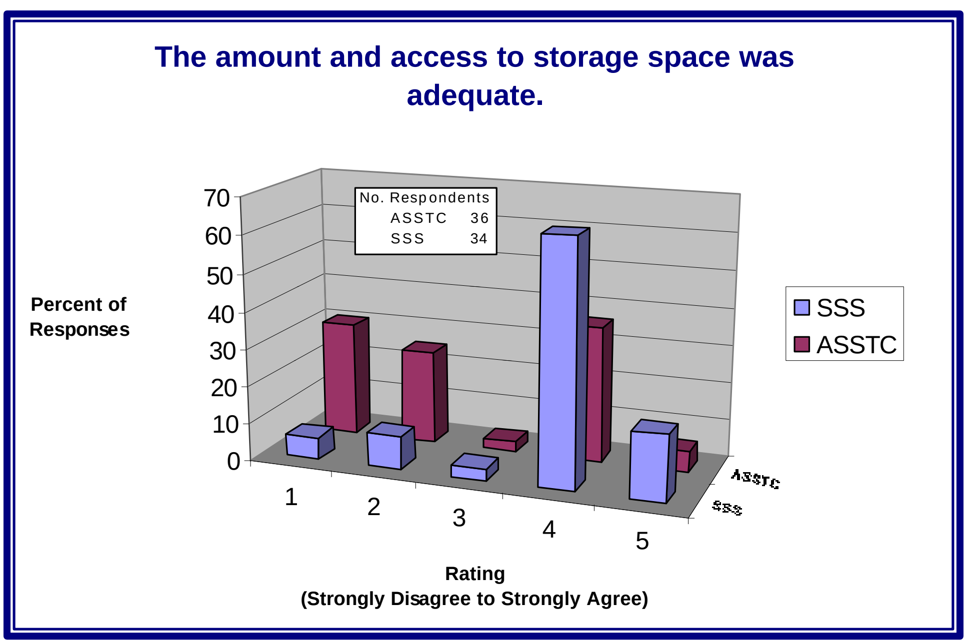
Functionality - Question 7



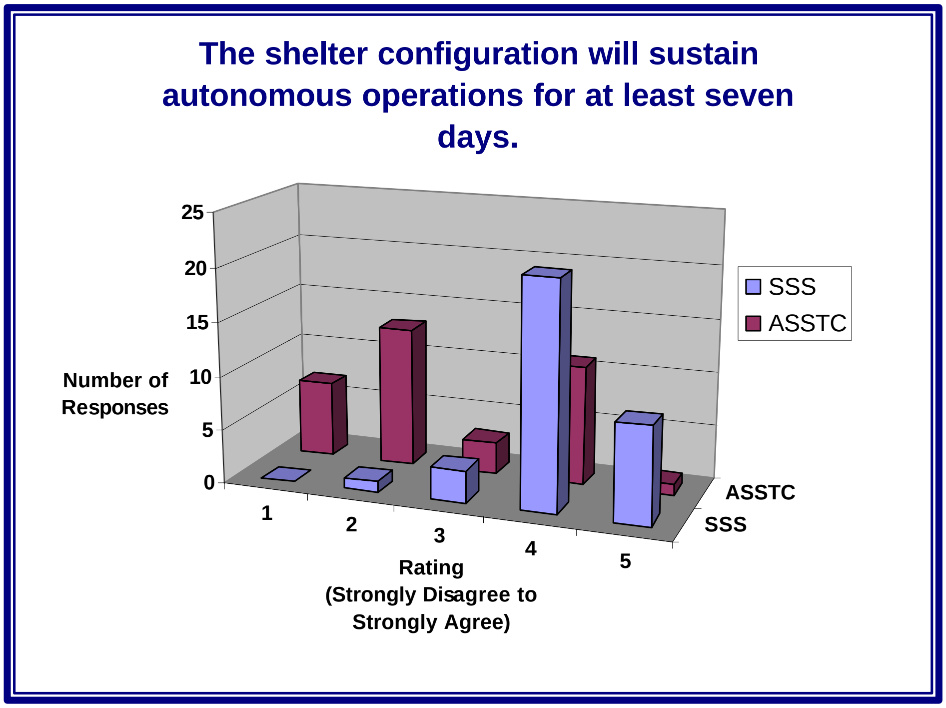


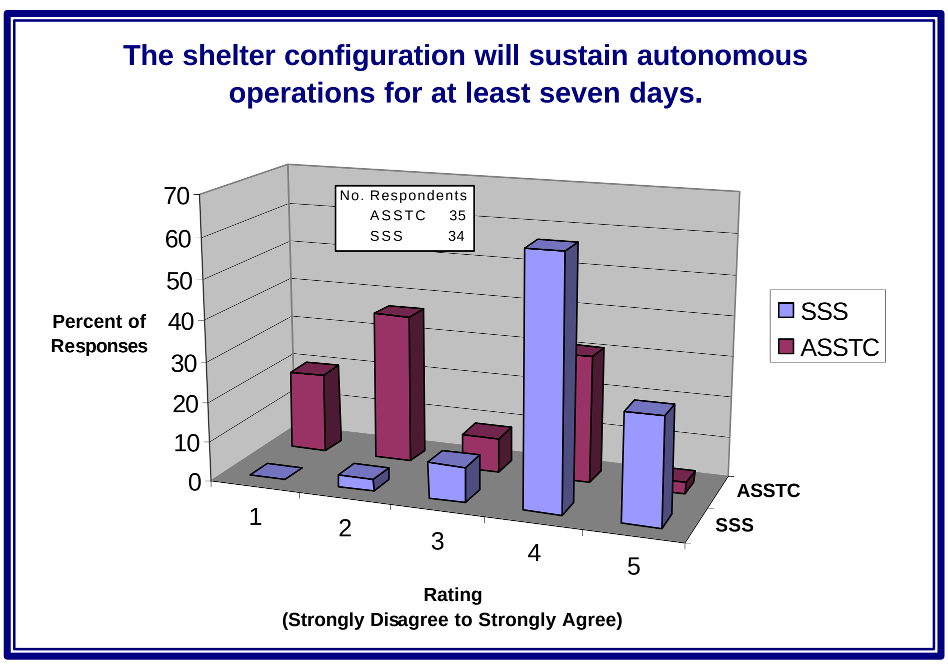
Functionality - Question 8



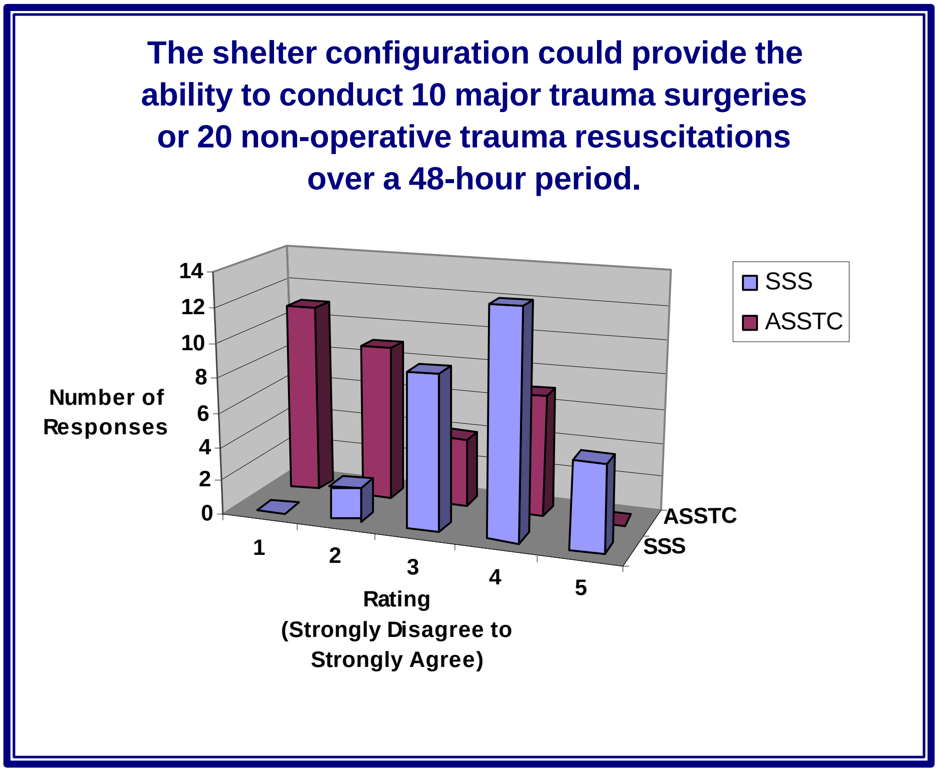


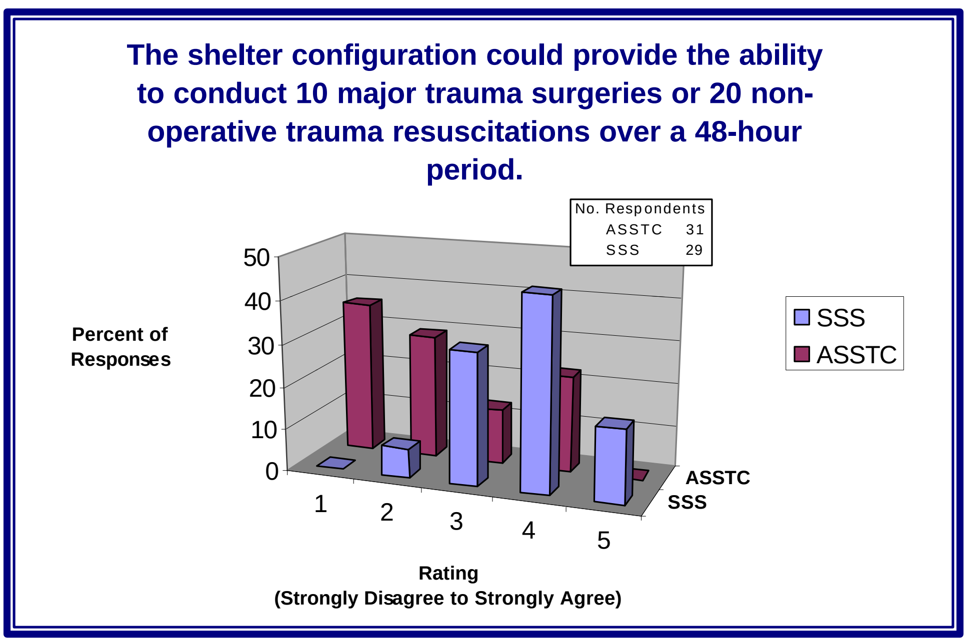
Functionality - Question 9



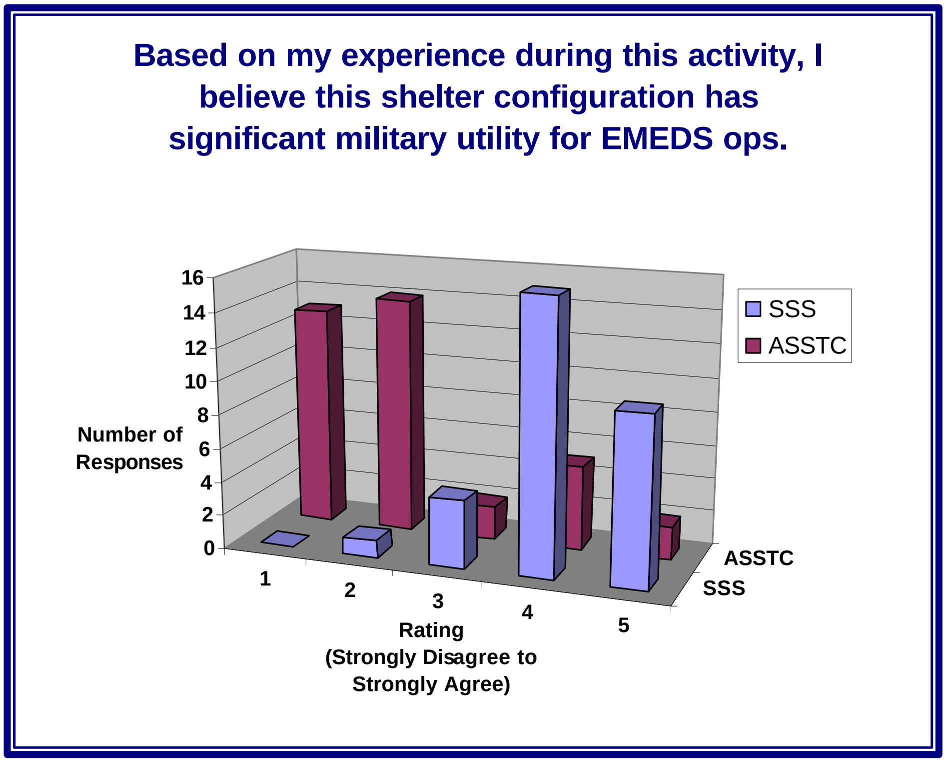


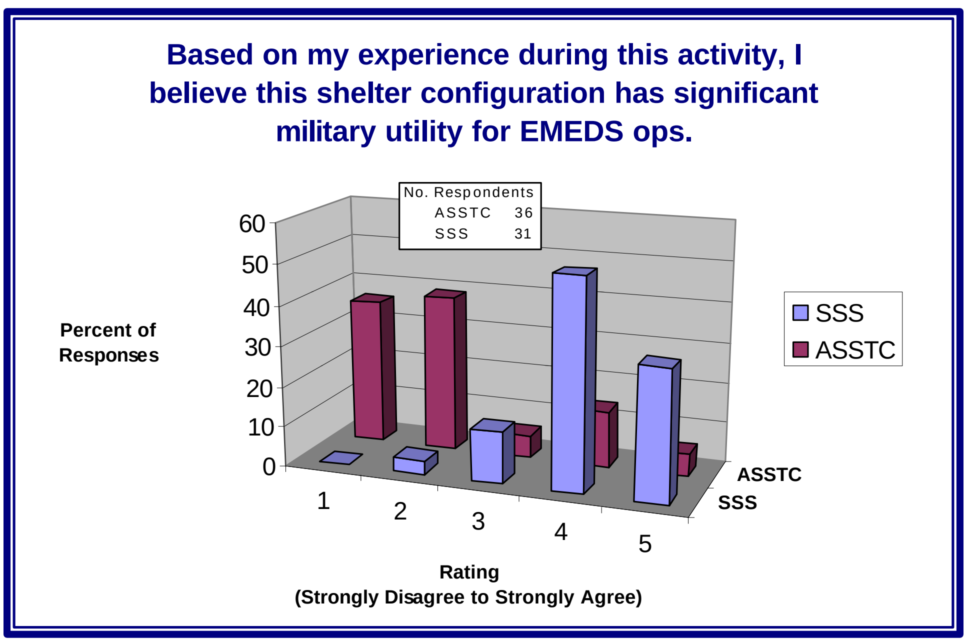
Functionality - Question 10





Functionality - Question 11





ANNEX E – OBJECTIVE 1 QUESTIONNAIRE RESULTS

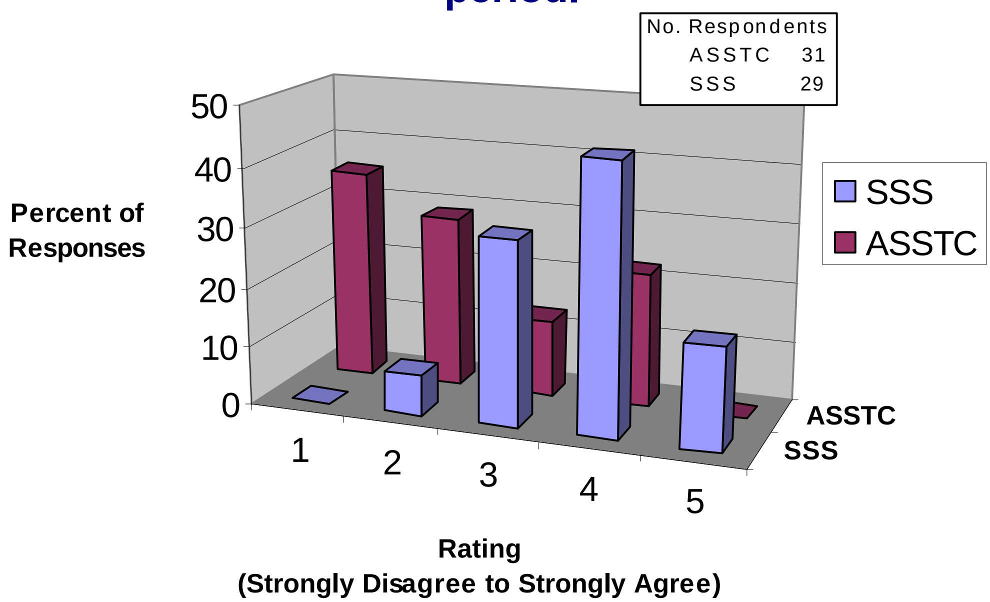
INTRODUCTION

This annex provides the results of the *"Medical Functionality During Typical Activities"* questionnaire completed by the members of the EMEDS team during the CATH assessment. The responses to the questionnaire have been grouped for each question after sorting for those respondents specifically performing the MOE related function. Results are portrayed in a bar chart for each MOE depicting the percent of responses falling into each rating category, along with a narrative comment regarding the results.

MOE 1-1

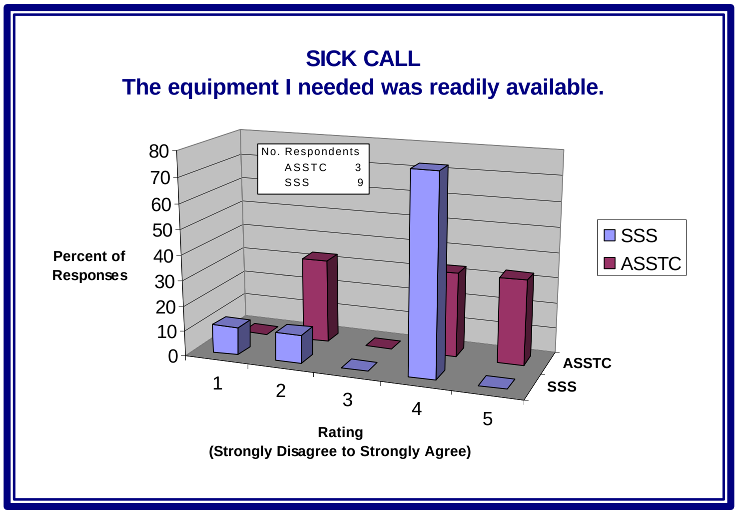
Results: The responses of the medical team regarding the ability of each shelter to sustain trauma operations clearly reflect a preference for the SSS configuration.

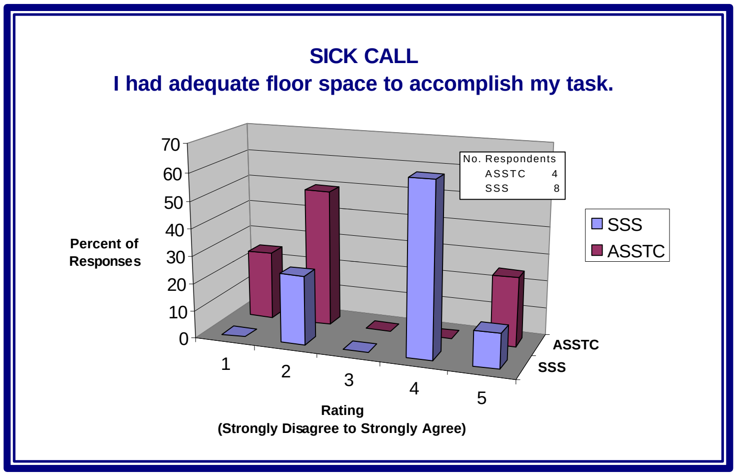
The shelter configuration could provide the ability to conduct 10 major trauma surgeries or 20 non-operative trauma resuscitations over a 48-hour period.

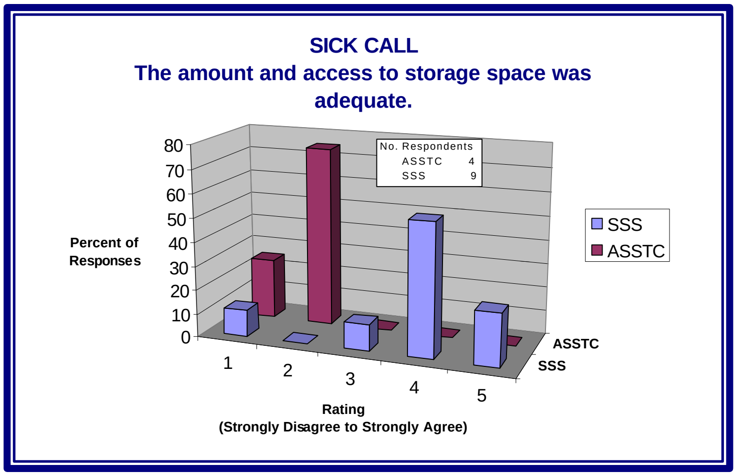


MOE 1-2

Results: Three questions were related to the ability of the shelters to accommodate the sick call function of the EMEDS. The questions dealt with equipment availability, floor space, and storage space. As evidenced by the graphs, the majority of responses fell into the "agree" range of the SSS configuration for all three questions. The medical personnel were not impressed with the ability of the ASSTC configuration during performance of the sick call function.

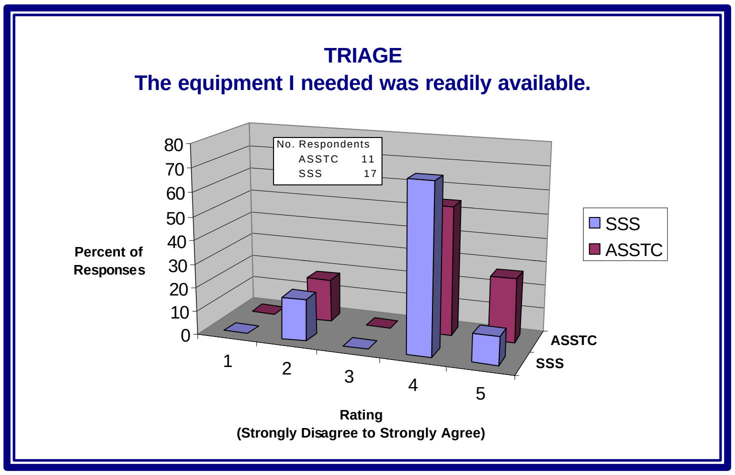


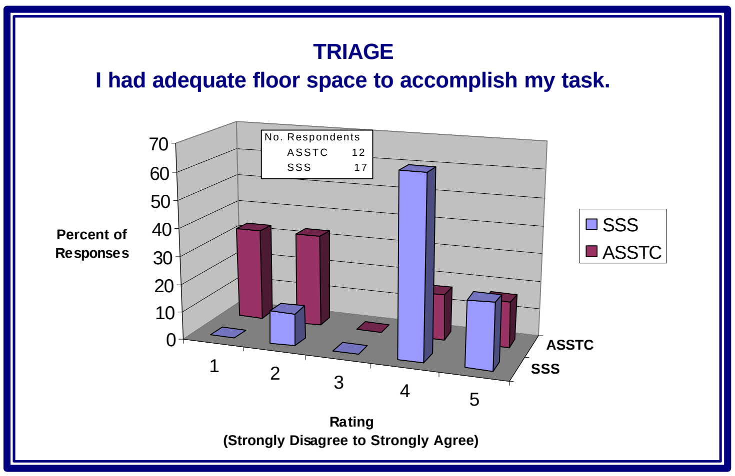


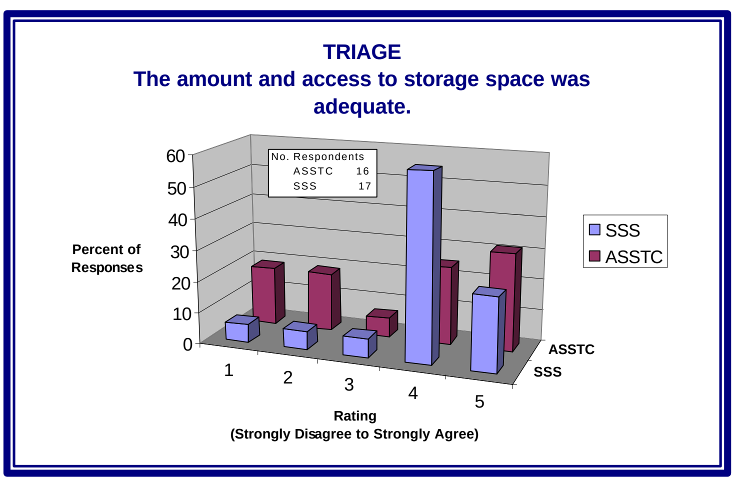


MOE 1-3

Results: As for the sick call function in the previous MOE, three questions pertained to the ability of the shelters to accommodate the EMEDS team during triage: equipment availability, floor space, and storage space. Although there was no preference related to equipment availability, some preference for the SSS configuration is evidenced for floor space and storage access.

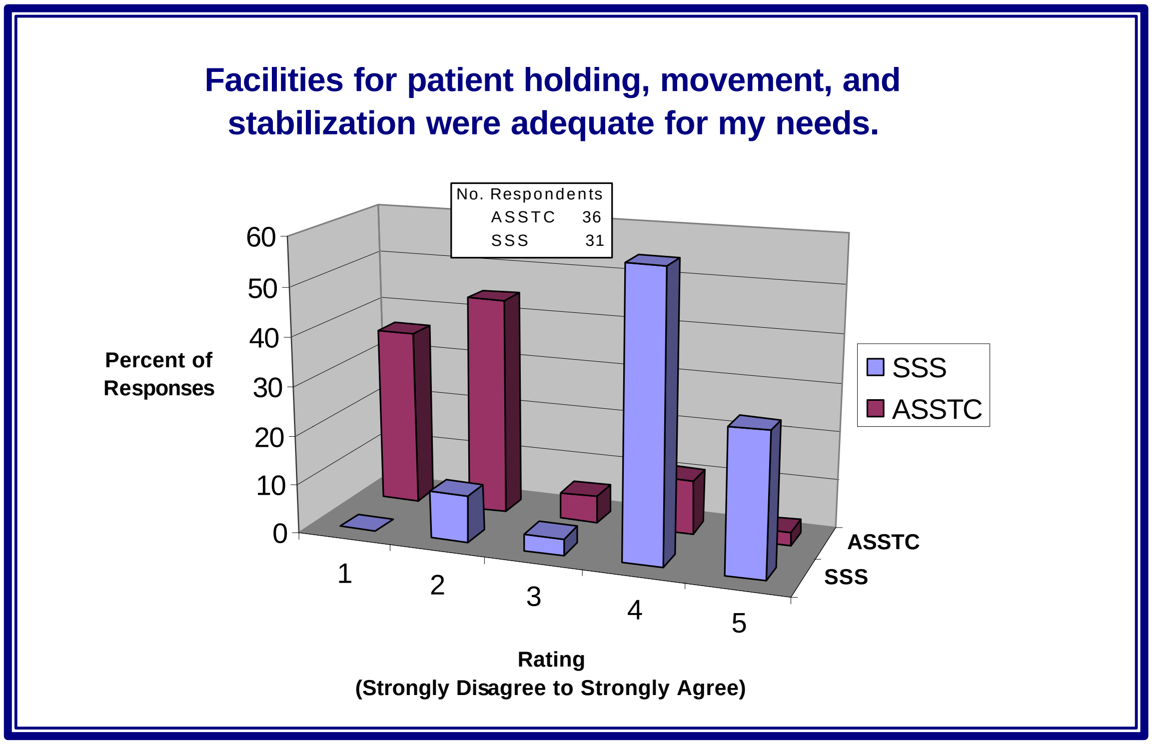






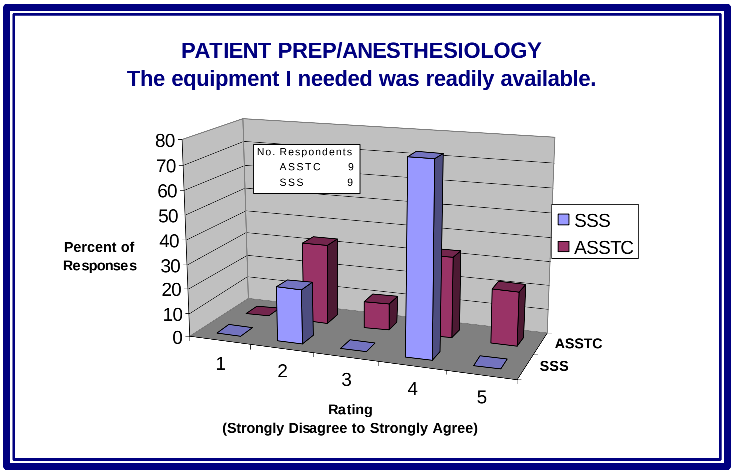
MOE 1-4

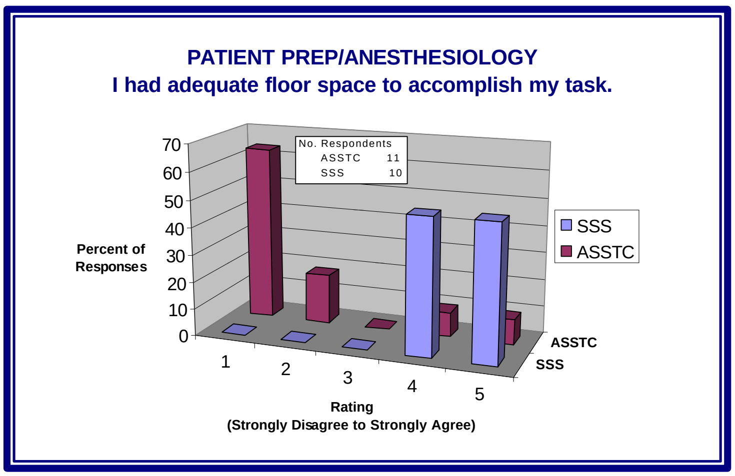
Results: The responses of the medical team regarding the capability of the facilities to accommodate patient movement, holding, and stabilization strongly favored the SSS configuration. This is largely due to the difficulty of being able to see all beds in the ASSTC and the inability to get to both sides of the beds to perform medical functions.

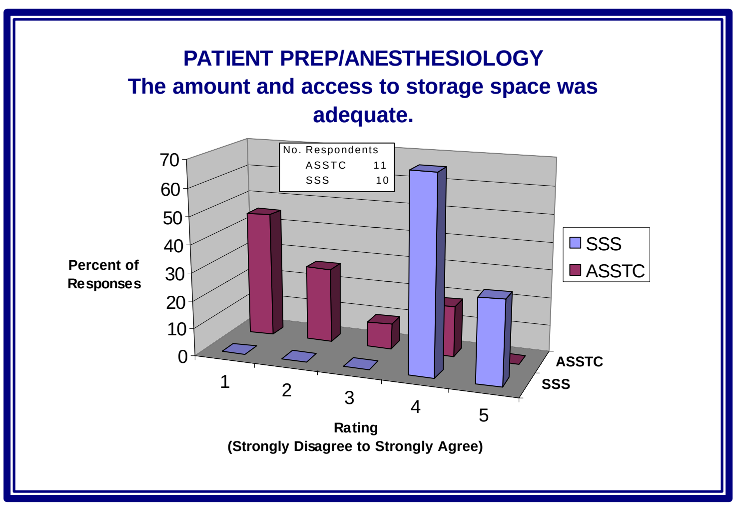


MOE 1-5

Results: The responses of the medical team regarding the availability of equipment, floor space, and storage for the patient prep/anesthesiology function again favored the SSS, especially regarding floor space and storage.

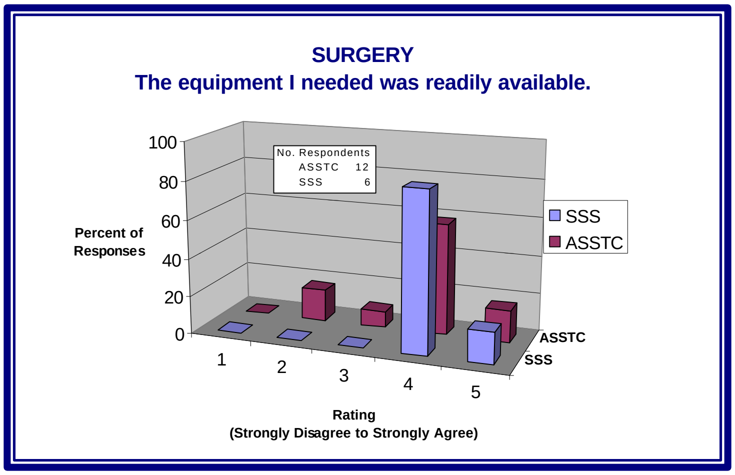


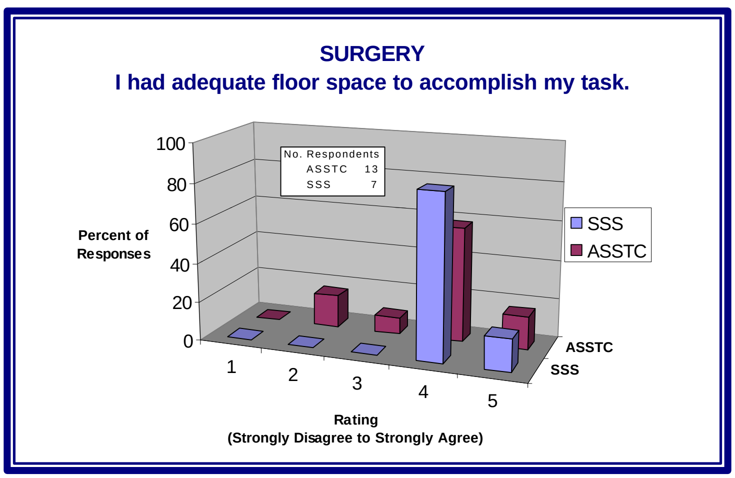


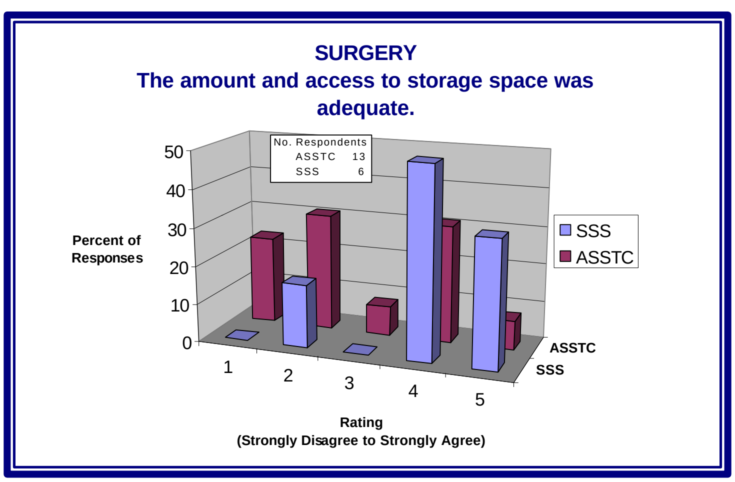


MOE 1-6

Results: Because the ASSTC was designed especially for trauma surgery, it fared nearly as well as the SSS in the ratings provided by the medical team members performing the surgical function, especially regarding equipment availability and floor space. Note, however, that since the ASSTC is only designed for one-bed surgery, the medical team was not satisfied with the amount of space available.

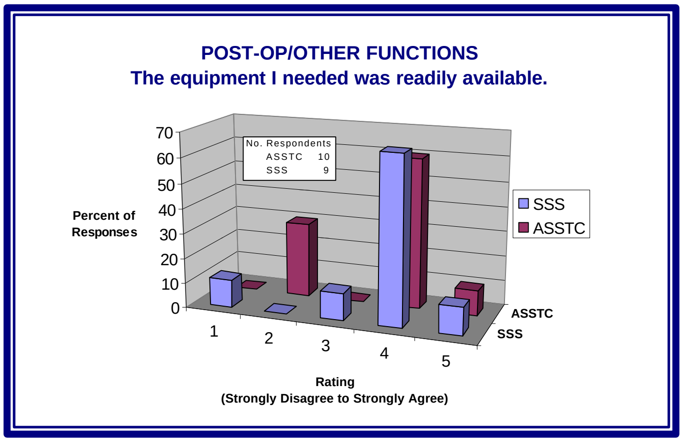


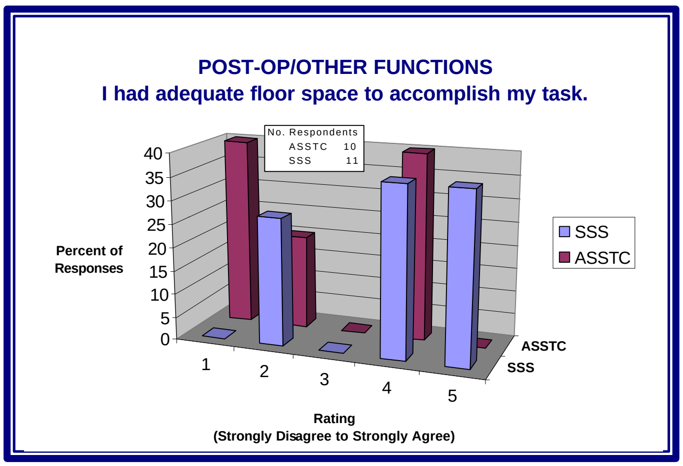


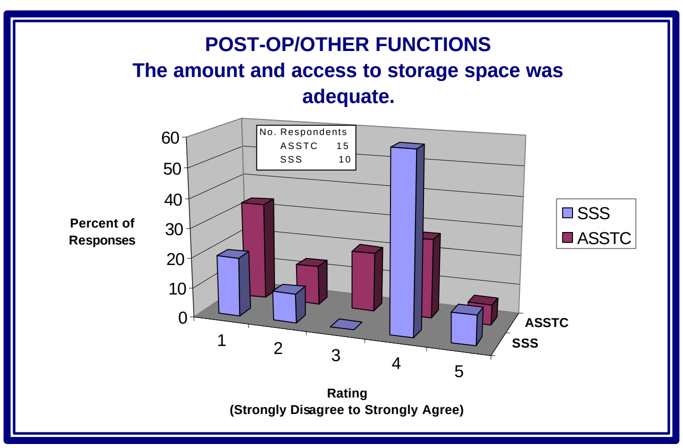


MOE 1-7

Results: A summarization of responses is included here for EMEDS team members who indicated "post-op" or "other" as the function performed on the *Medical Functionality During Typical Activities Questionnaire*. The responses regarding the ability of the shelters to support post-op and other functions were mixed. The majority of the respondents agreed that equipment needed was readily available in both shelters. Although the majority of respondents were satisfied with the floor space in the SSS, they were strongly divided regarding the ASSTC. Access to storage in the SSS was favorable, with opinions strongly divided for the ASSTC.

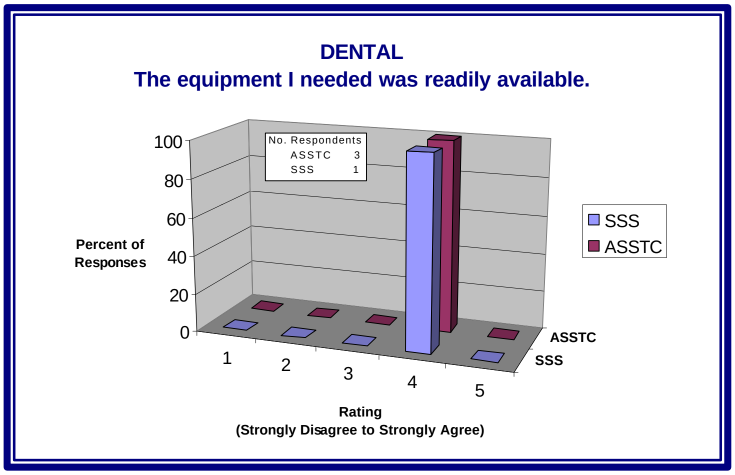


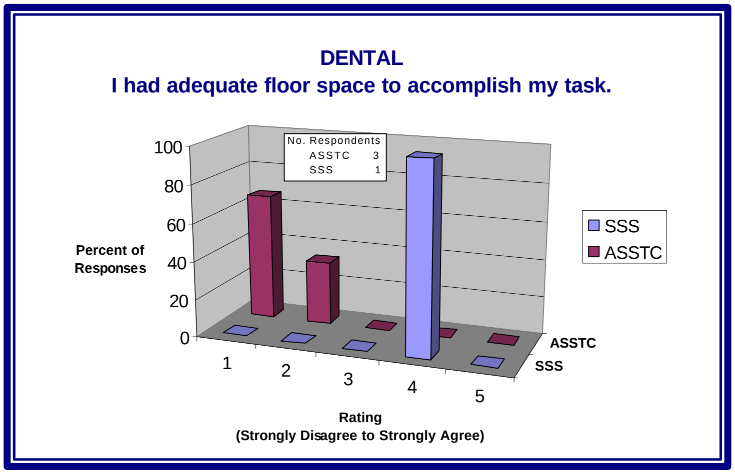


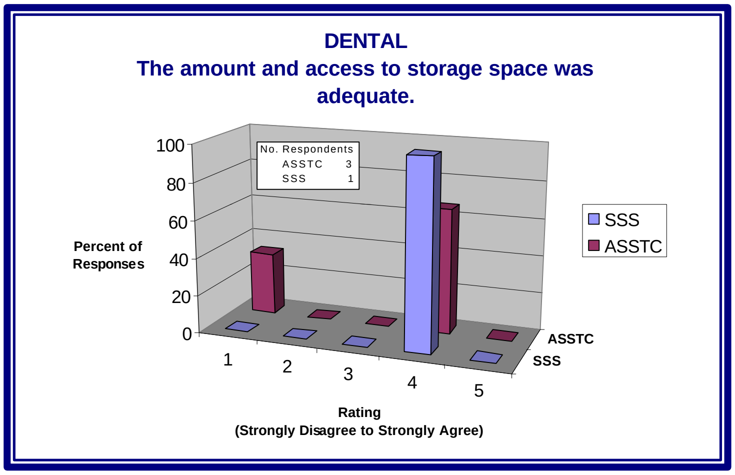


MOE 1-8

Results: The sample size of respondents for the dental function was quite small. Nevertheless, the ASSTC did not meet dental needs for floor space, with the SSS preferred.

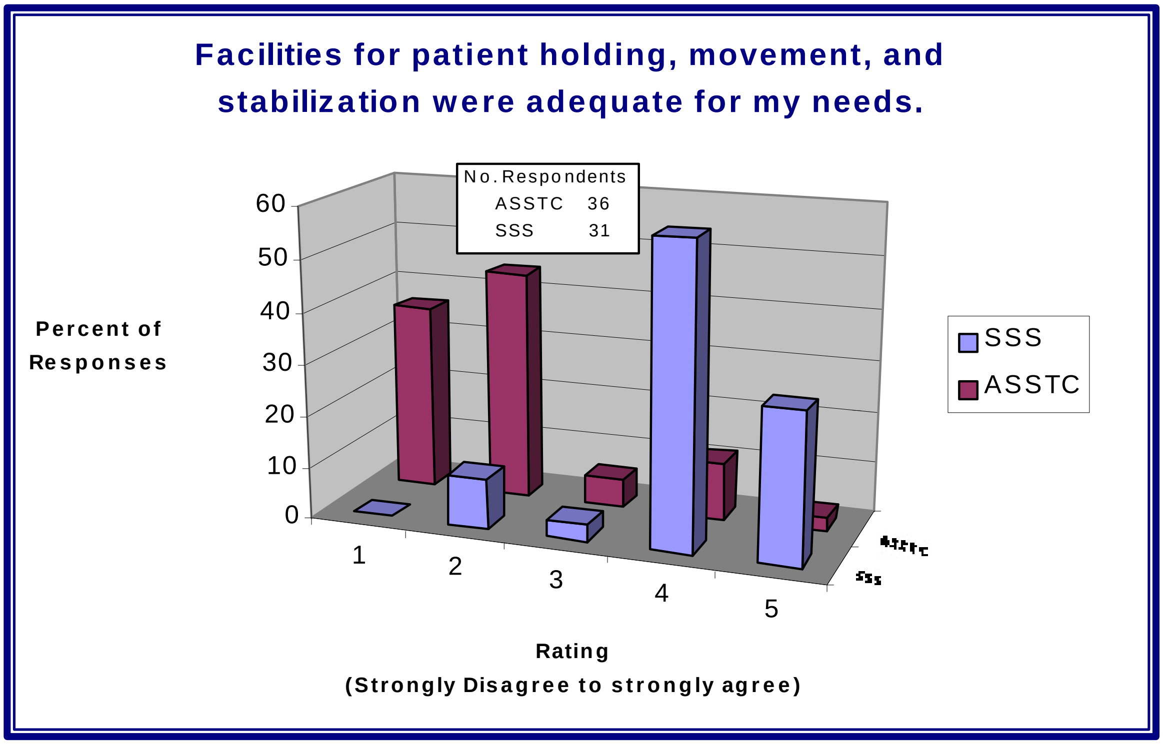






MOE 1-9

Results: The participant responses for MOE 1-9 are included with the results for MOE 1-4. The responses of the medical team regarding the capability of the facilities to accommodate patient holding, movement, and stabilization strongly favored the SSS configuration.



ANNEX F – OBJECTIVE 2 DETAILED TABLES

Table F-1. Shelter Shipping Weights

	ASSTC Configuration		SSS Configuration		TEMPER/ESC Configuration	
Weight	1 x ASSTC	3,600 lbs.	1 x SSS	1,223 lbs.	1 x ESC	4,220 lbs.
	1 x SSS	1,223 lbs.	1 x SSS	1,223 lbs.	1 x TEMPER	1,240 lbs.
	1 x SSS	1,223 lbs.	1 x SSS	1,223 lbs.	1 x TEMPER	1,240 lbs.
	Subtotal	**6,046 lbs.**	**Subtotal**	**3,669 lbs.**	**Subtotal**	**6,700 lbs.**
	1 x ECU	611 lbs.	1 x ECU	611 lbs.	1 x ECU*	920 lbs.
	1 x ECU	611 lbs.	1 x ECU	611 lbs.	1 x ECU*	920 lbs.
			1 x ECU	611 lbs.	1 x ECU*	920 lbs.
	Total	**7,268 lbs.**	**Total**	**5,502 lbs.**	**Total**	**9,460 lbs.**

NOTE: None of the configurations include MRSP in totals.
* ECU in this configuration is the –39.

Table F-2. Shelter Shipping Volumes

	ASSTC Configuration		SSS Configuration		TEMPER/ESC Configuration	
Shipping Volume	1 x ASSTC	250 cu. ft.	1 x SSS	81 cu. ft.	1 x ESC	853 cu. ft.
	1 x SSS	81 cu. ft.	1 x SSS	81 cu. ft.	1 x TEMPER	112 cu. ft.
	1 x SSS	81 cu. ft.	1 x SSS	81 cu. ft.	1 x TEMPER	112 cu. ft.
	Subtotal	**412 cu. ft.**	**Subtotal**	**243 cu. ft.**	**Subtotal**	**1077 cu. ft.**
	1 x ECU	40 cu. ft.	1 x ECU	40 cu. ft.	1 x ECU*	64 cu. ft.
	1 x ECU	40 cu. ft.	1 x ECU	40 cu. ft.	1 x ECU*	64 cu. ft.
			1 x ECU	40 cu. ft.	1 x ECU*	64 cu. ft.
	Total	**492 cu. ft.**	**Total**	**363 cu. ft.**	**Total**	**1269 cu. ft.**

NOTE: None of the configurations include MRSP in totals.
* ECU in this configuration is the –39.

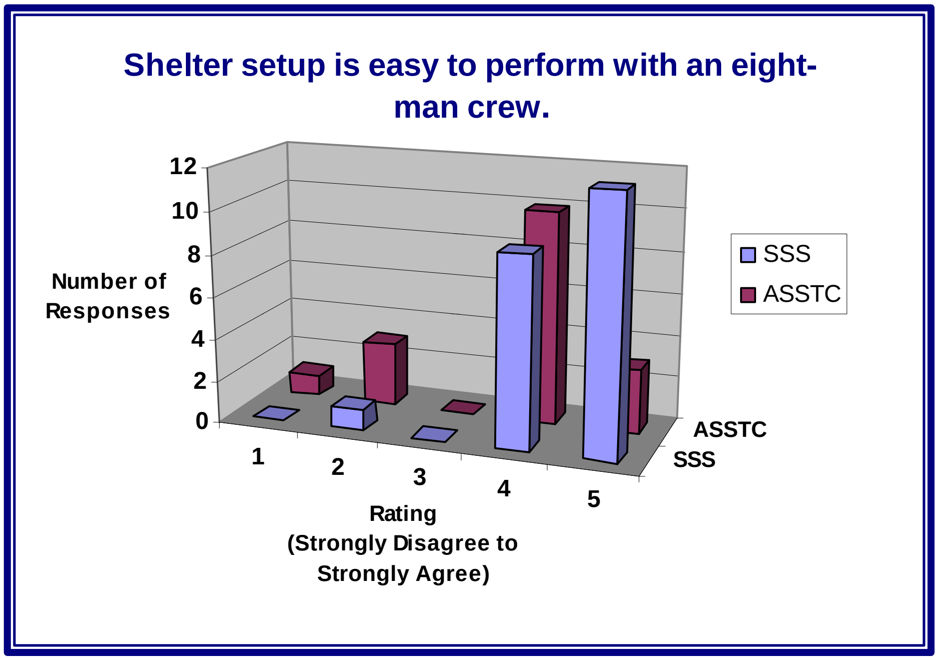
Table F-3. Shelter Pallet Space (PS) Required

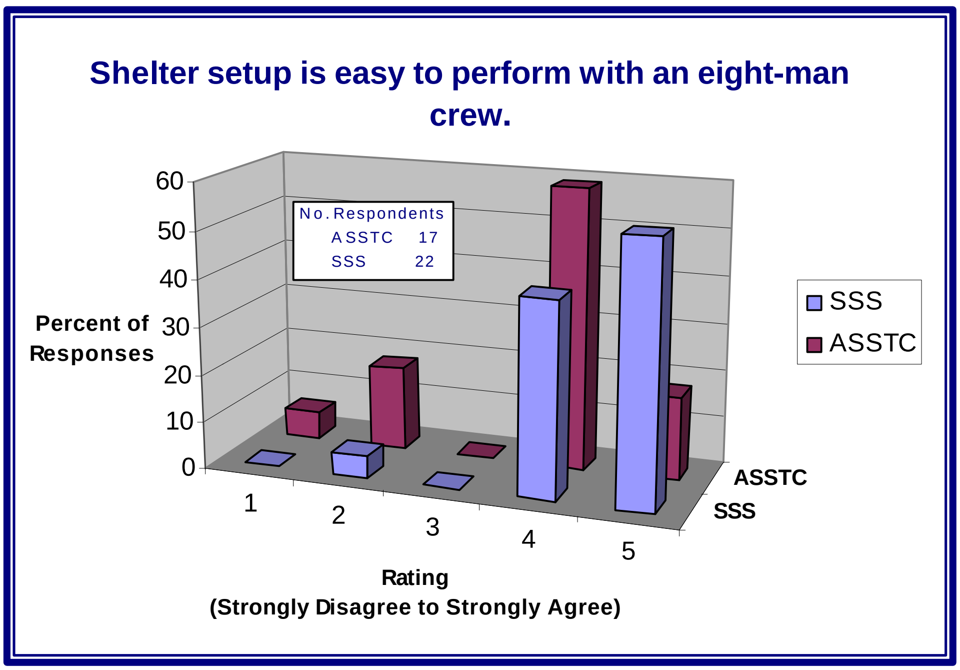
	ASSTC Configuration		SSS Configuration		TEMPER/ESC Configuration	
Pallet Space	1 x ASSTC	1/2 PS	1 x SSS	1/6 PS	1 x ESC	2 PS
	1 x SSS	1/6 PS	1 x SSS	1/6 PS	1 x TEMPER	Inside ESC
	1 x SSS	1/6 PS	1 x SSS	1/6 PS	1 x TEMPER	Inside ESC
	Subtotal	**5/6 PS**	**Subtotal**	**1/2 PS**	**Subtotal**	**2 PS**
	2 x ECU	1/6 PS	3 x ECU	1/4 PS	3 x ECUs*	1/3 PS
	Total	**1 PS**	**Total**	**3/4 PS**	**Total**	**2 1/3 PS (approx.) ** Plus 240 cu. ft. of internal storage available**

NOTE: None of the configurations include MRSP in totals.
* ECU in this configuration is the –39.

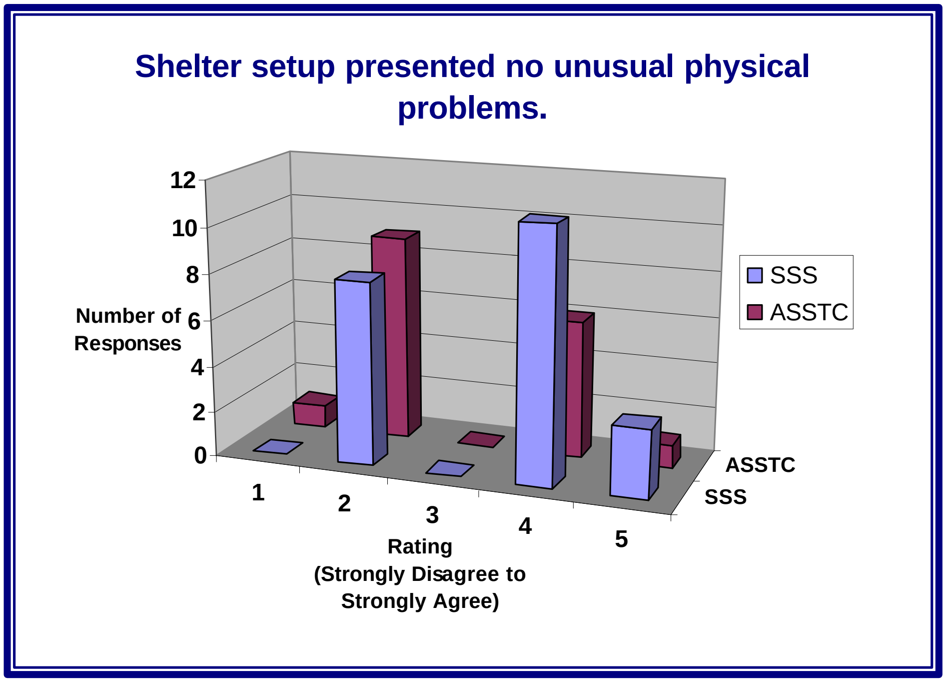
ANNEX G – SHELTER SETUP RESULTS

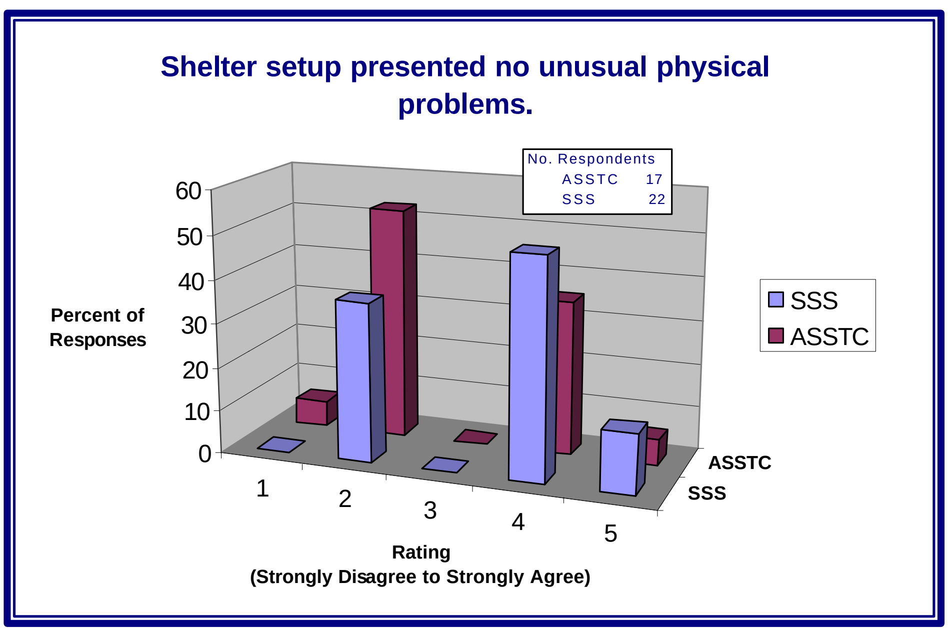
Setup - Question 1



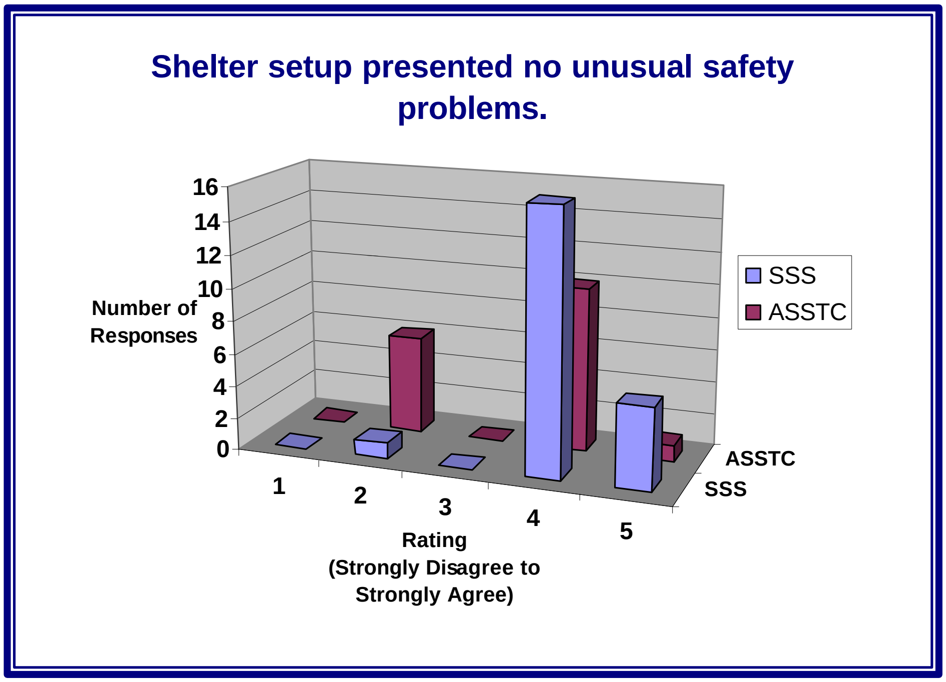


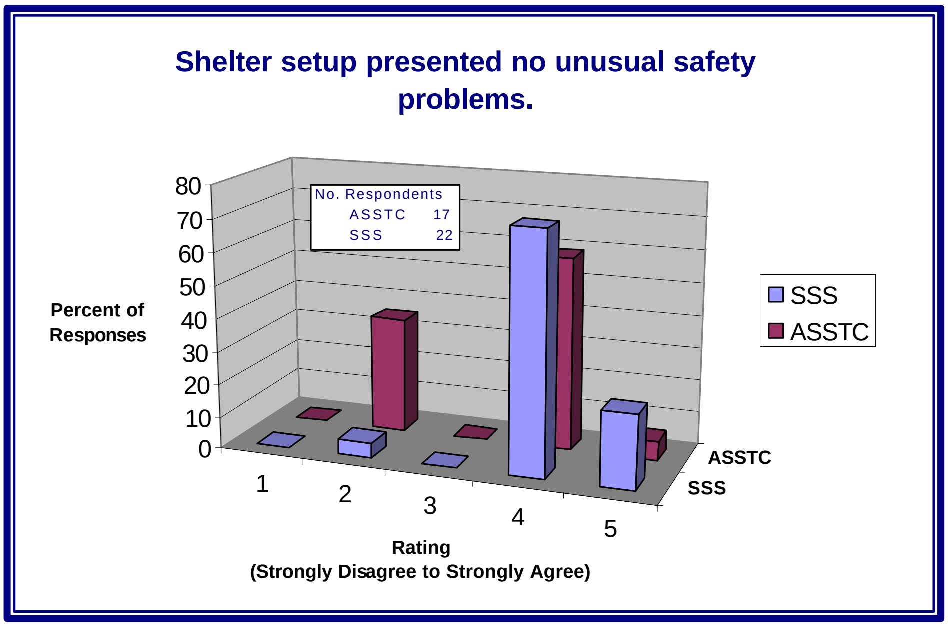
Setup - Question 2



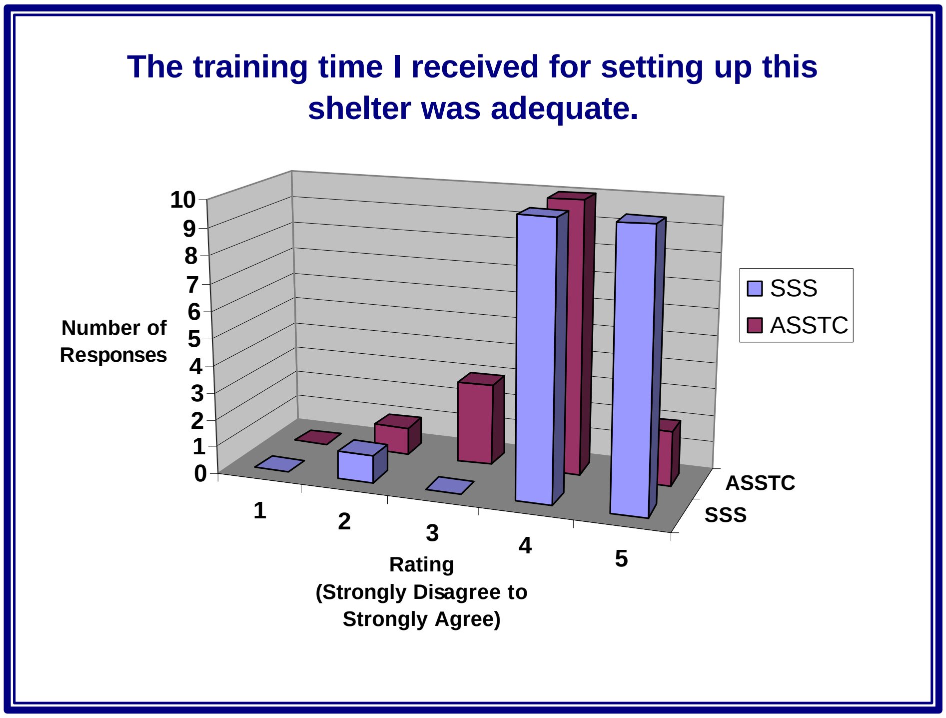


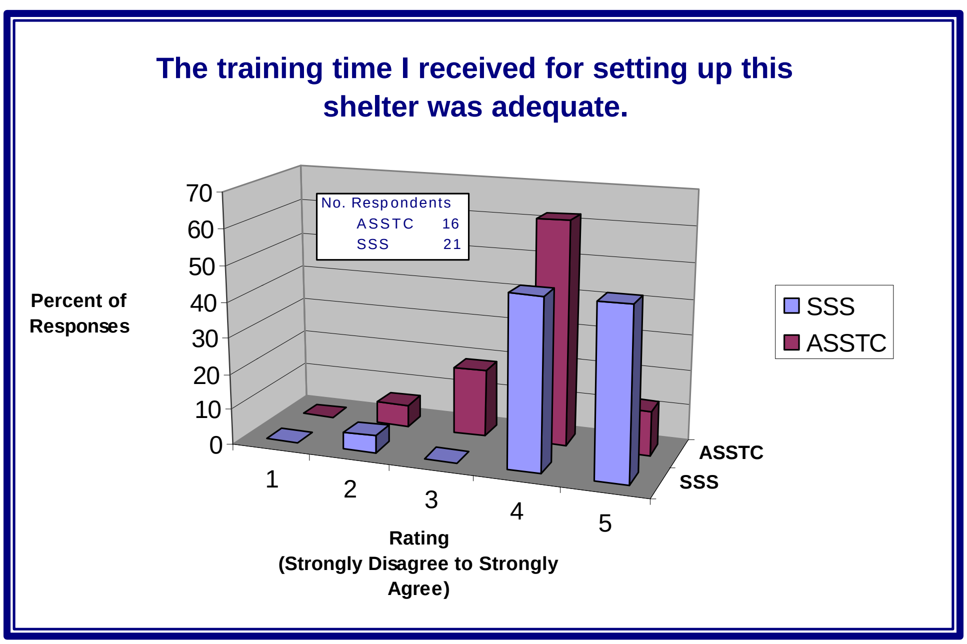
Setup - Question 3



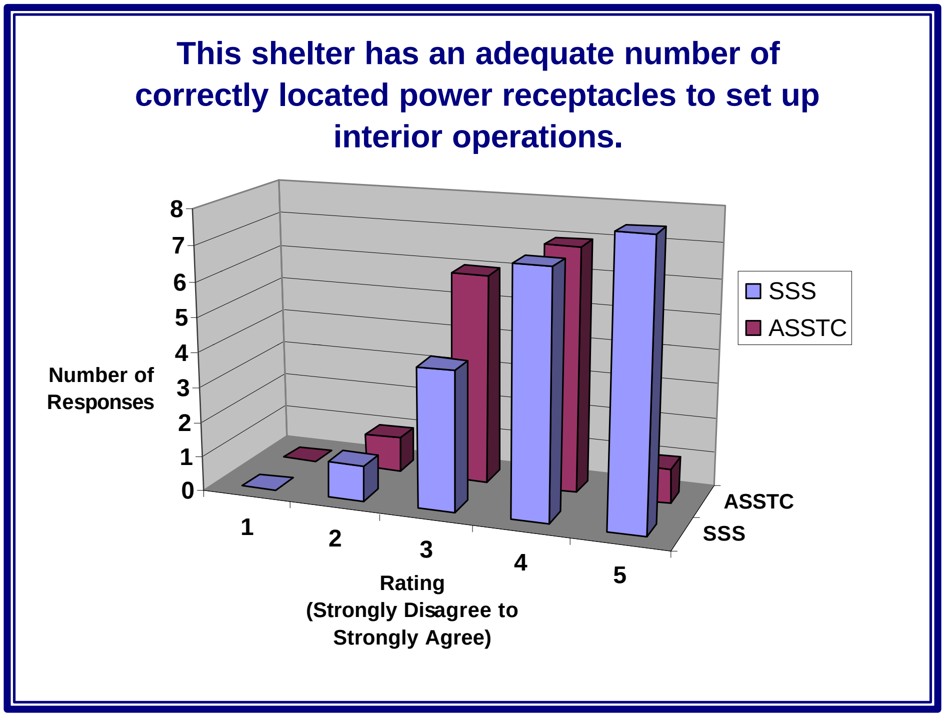


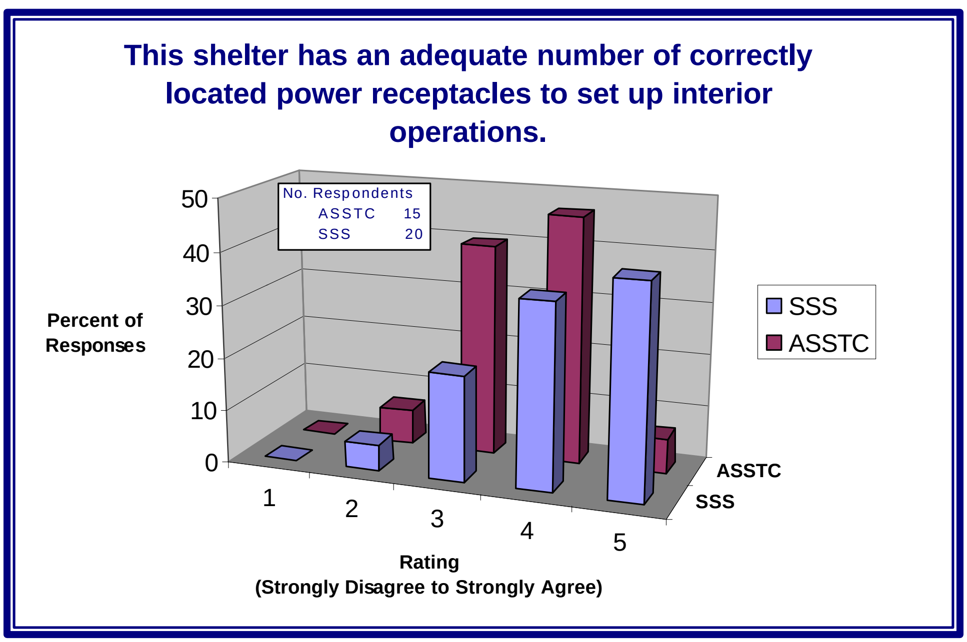
Setup - Question 4



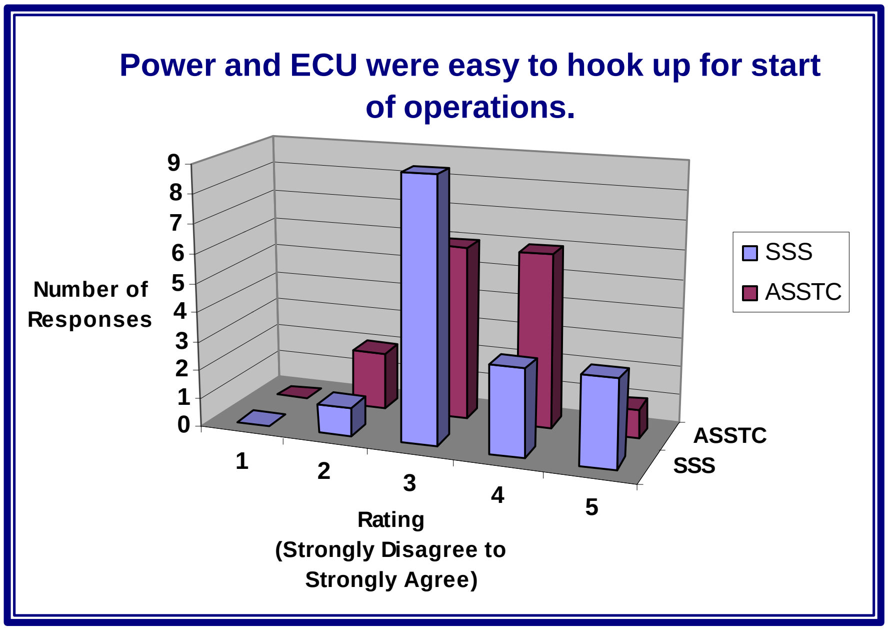


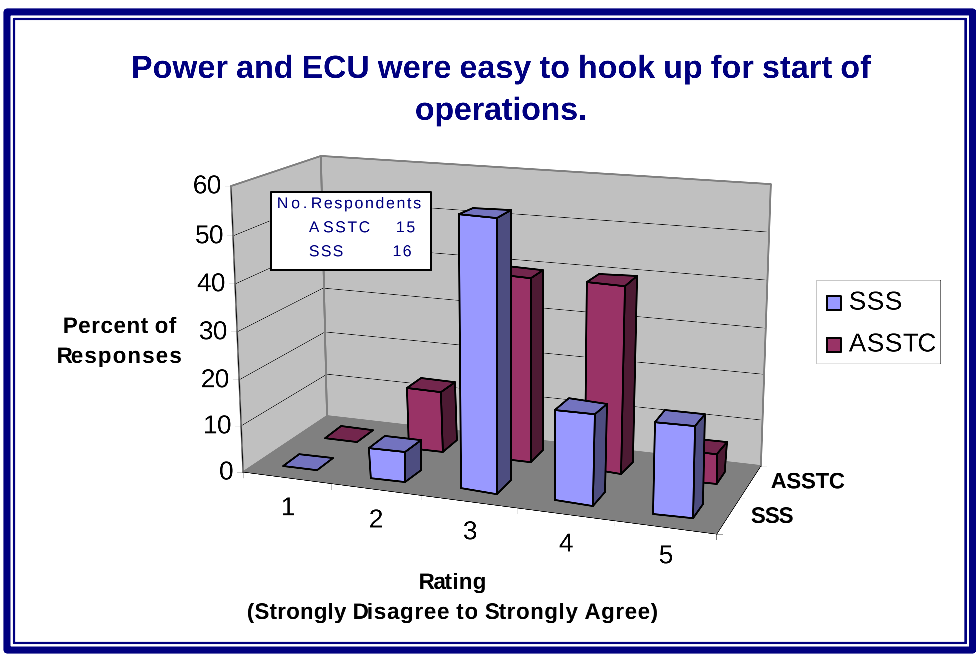
Setup - Question 5



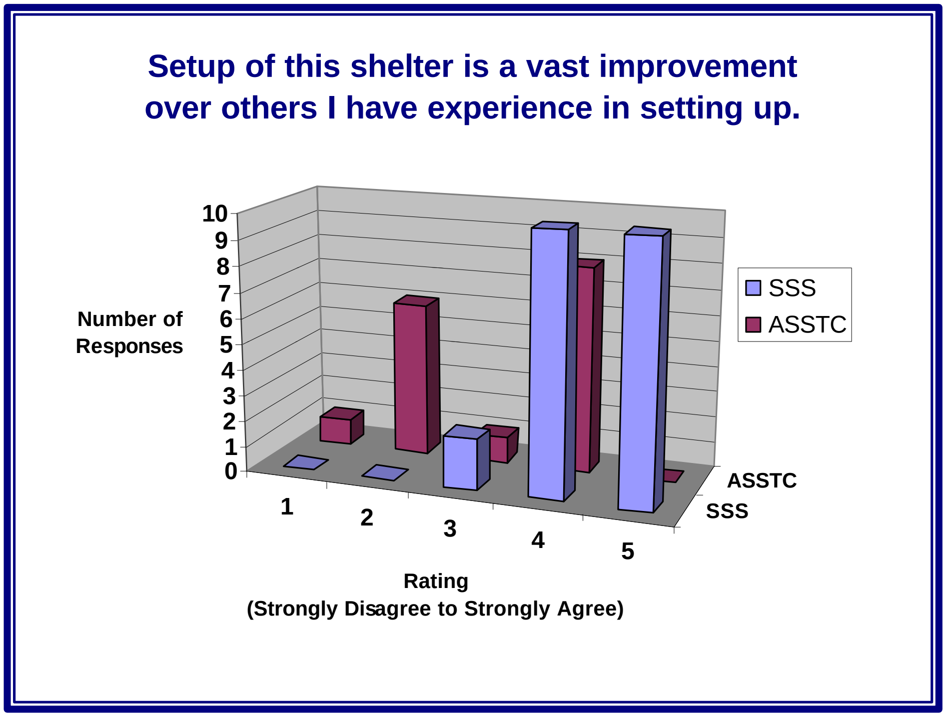


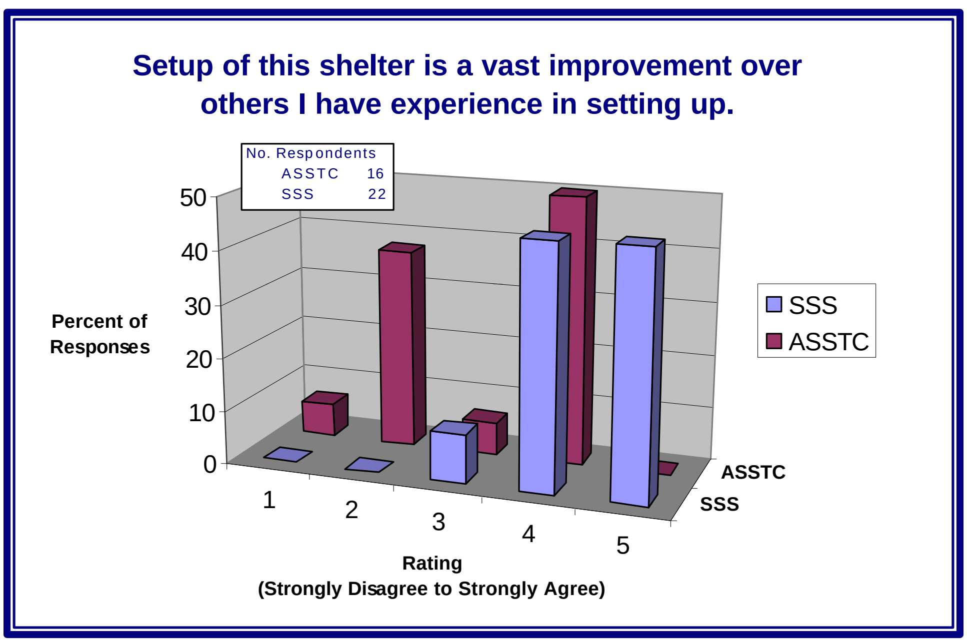
Setup - Question 6





Setup - Question 7





ANNEX H – ENVIORNMENTAL MEASURES

Light Level Measurements

	SSS Shelter		ASSTC Shelter		Vestibule
Date/Time	Location	Reading (lumens)	Location	Reading (lumens)	Reading (lumens)
02/1215	Right Front #1	180.5	OR Center	188.8	75.5
	Left Front #1	166	Periphery	9.7	
	Center #1	37.8	Periphery	9.2	
	Right Rear #1	25.5	Periphery	7.3	
	Left Rear #1	22.8	Periphery	4.5	
03/0700	Right Front #1	26.6	OR Center	159	7.1
	Left Front #1	20	Periphery	13.6	
	Center #1	9.4	Periphery	7.1	
	Right Rear #1	18.3	Periphery	5.4	
	Left Rear #1	14.9	Periphery	3.7	
05/0830	OR Center #3	10.5			4.1
	Right Front #3	3.3			
	Left Front #3	2.9			
	Center #3	9			
	Right Rear #3	4.5			
	Left Rear #3	4.4			

Peak Noise Level Measurements

	Shelter Readings (dB)		Outside	
Date/Time	SSS	ASSTC	Readings (dB)	Comments
02/1106	95.9	92		SSS right side
02/1106	77.2			SSS left side
02/1142	61.8	99.2		
02/1144	95	102		
02/1304	100.8	97.8		
02/1312			99.4	B-1B overflight
02/1330	95.9	105.3	99.2	
02/1400	99.9	99.4	93.1	
03/0718	103	102.3	79	
03/0800	98.3	97.5	94.6	
03/0836	94	87.3	94.4	
03/0930	94	93.4	85.6	
03/1010	94	97.7	97.4	
03/1100	90.8		99	
03/1252	96.5		92.7	SSS #1
03/1252	95.3			SSS #3
03/1325	88.9		96.9	SSS #1
03/1400	81.8		100.7	SSS #1
03/1430	87.2		87.7	SSS #1
03/1502	96.5		101.5	SSS #1
03/1502	105.1			SSS #3

Dust and Particulate Measurements

Date/Time	Shelter Readings (mg/m3) SSS	Shelter Readings (mg/m3) ASSTC	Outside Readings (mg/m3)	Comments
02/1038			0.007	
02/1141		0.02		
02/1144	0.038			
02/1304		0.071	0.005	
02/1304		0.056	0.005	
02/1330	0.044	0.038	0.006	
02/1400	0.044	0.06	0.013	
03/0718	0.062	0.07	0.028	
03/0800	0.068	0.044	0.03	
03/0836	0.085	0.069	0.03	
03/0930	1.095	1.113	0.035	
03/1016	0.065	0.112	0.025	
03/1100	0.046	0.064	0.038	
03/1252	0.038	0.048	0.02	
03/1335	0.06	0.165	0.02	
03/1400	0.046	0.053	0.022	

Temperature Measurements

Date/Time	Shelter Readings (F) SSS	Shelter Readings (F) ASSTC	Outside Readings (F)	Comments
02/1330	70	71	53	
02/1400	71			Machine unplugged
03/0718	67	51		
03/0800	72	60	42	
03/0836	72	69	58	
03/0930	65	71	53	
03/1010	68	72	59	
03/1100	68	75	66	
03/1252	71		70	SSS#1
03/1252	77		67	SSS#3
03/1335	73		72	SSS#1
03/1335	77		65	SSS#3
03/1400	77		74	SSS#1
03/1400	77		66	SSS#3
03/1430	78		75	SSS#1
03/1430	76		65	SSS#3
03/1502	74		87	SSS#1
03/1502	74		65	SSS#3

ANNEX I – AFTER ACTION REPORTS

This annex contains various After Action Reports provided by F-4 participants and observers.

Contents:

MEMORANDUM FOR HQ ACC/SGX 12 February 99

FROM: Expeditionary Medical Support Team
-366th Medical Group, Mountain Home AFB, ID
-59th Medical Wing, Lackland AFB, San Antonio, TX

SUBJECT: Medical after-action report for the Form, Fit and Function and Follow-up (F4) Exercise, Camp Cobra, Nellis AFB.

1. Concept - The F4 exercise is designed to comply with HQ USAF/SGX objective to evaluate the Air Force Medical Service's new medical specialty sets. The Expeditionary Medical Support (EMEDS) is the proposed medical force package for future AEF deployments. EMEDS consists of a 24 member medical team and supplies equivalent to three full pallet positions. The package can support up to 2,000 deployed personnel, and is capable of operating independent of host nation support. Employment of EMEDS starts with the medical ADVON team, which is composed of a flight surgeon and Public Health Officer or Independent Medical Duty Technician (IDMT). This is followed by a 5 person Mobile Field Surgical Team (MFST) with the remainder of package (additional 17 persons and 3 equipment pallets) to follow within the next 24 hours. EMEDS capability will include primary care, resuscitative surgery, dental, intensive care, flight medicine, preventive medicine, and orthopedics.

The EMEDS objectives for the F4 exercise were:

❶ Evaluate two shelter systems for medical use:
  - Advanced Surgical Suite for Trauma Care (ASSTC)
  - USAF Small Shelter System (SSS) for billeting

❷ Determine the medical footprint of EMEDS Basic
❸ Compare and evaluate off-the-shelf and emerging technologies
❹ Assess patient flow and medical functionality within shelters
❺ Utilize animal lab to demonstrate EMEDS capabilities and multi-functionality of personnel

2. Significant Activities. The EMEDS basic package (Supplies and Personnel) arrived at Camp Cobra, Nellis AFB on 31 January 1999. Initial operating capability (IOC) for the ADVON and MFST teams was within 30 minutes of arrival to Camp Cobra. Full operating capability was obtained within 8 hours. The shelters were evaluated under an AEF Battlelab initiative entitled Compact Air Transportable Hospital. This evaluation was conducted with the assistance of the Air Force Operational Test and Evaluation Center (AFOTEC) Det 1. The shelter parameters demonstrated during this exercise included cube and weight, set-up time, footprint, medical functionality and patient flow. A final report on the evaluation is due 30 days following the conclusion of this phase of the exercise (March 7). EMEDS medical capabilities were assessed utilizing mannequins and an animal lab to evaluate triage, emergency resuscitation, surgical stabilization, post operative recovery and critical care. A number of commercial, off-the-shelf, and emerging technologies were assessed. EMEDS AFSC multi-functionality concept was demonstrated.

3. Attainment of Objectives. The EMEDS objectives established for the F4 exercise were attained. Due to ongoing development of EMEDS allowance standards, the material status for this UTC was unavailable. The FFCCT and MFST equipment and personnel arrived on site and were operational within established parameters.

TIME AND DATE

- Deployment: 31 January 1999, 0800

- Terminated Operation/Rotation/Exercise: 6 February 1999, 1800
- Redeployment: 7 February 1999, 1700
- Arrival Home Station: February 1999, 1940

4. Manpower. 3,456 man hours (does not include travel days or pre- and post-deployment activities) were utilized by the 24 EMEDS personnel team.

5. Observations and Recommendations.

EMEDS

Supplies/Equipment
1. Observation. Medical supplies/equipment are not labeled or stored in consistent areas within the EMEDS facility.
2. Discussion. EMEDS personnel were unfamiliar where supplies are stored throughout the facility and had difficulty finding them when needed. This problem was aggravated during mass casualty scenarios.
3. Recommendation: Develop plan for consistent storage and labeling of supplies/equipment throughout EMEDS facility. Supplies/equipment for Functional Area Codes should be packed together when possible (POC: MSgt CassoLopez, 366TH MDG).

Patient Accountability
1. Observation. Patient tracking from encounter to disposition was inadequate.
2. Discussion. There is no mechanism in place for tracking patients during mass casualty scenario. This presents the potential for misinformation regarding patient status, delaying the up-channeling of information that may affect replacement or regulating into the AE system.
3. Recommendation. Structured patient tracking mechanism needs to be established. (POC: Lt Eckley, 366th MDG)

Identification of EMEDS Personnel
1. Observation. It was difficult to identify who the EMEDS personnel were.
2. Discussion. Increased number of personnel were at F4 (IPT members, vendors, 99th MDG personnel, etc.). EMEDS identification must be made clear—difficult to identify team members.
3. Recommendation. An identification system be developed (i.e., ID arm bands, hats, etc.). Nametags must be worn when outer blouse is removed (POC: Major Heglar, 366th MDG).

Technology Demonstration and Security
1. Observation. Having technology demonstrations at EMEDS increased the number of military and civilian personnel traversing through the facility.
2. Discussion. The technology demonstrations were extremely helpful. They allowed IPT and EMEDS members the opportunity to see and use new equipment. However, increased number of personnel interfered with patient flow and presented a security problem during animal lab.
3. Recommendation. Future technology demonstrations should be held in a separate tent (POC: Major Don Diesel, 366TH BL).

Promoting EMEDS Force Package
1. Observation. There is increasing interest in the EMEDS project at all levels.

2. Discussion. Under Secretary of Defense for Readiness unexpectedly was added onto the EMEDS schedule during F4. A "CAPSTONE" type presentation was utilized successfully. We were fortunate that the majority of the CAPSTONE presenters were at F4.
3. Recommendation. EMEDS members must develop and be prepared to provide briefings throughout validation phase of project to VIPs (POC: Major Heglar, 366TH MDG).

Pre-deployment—Medical Readiness
1. Observation. Communication of complete OPORD for F4 was not received by EMEDS.
2. Discussion. Command and Control was adversely impacted due to lack of detail on scenario development. EMEDS commander did not possess critical medical intelligence and logistical support information required during F4 exercise scenarios.
3. Recommendation. Complete dissemination of OPORD to all participating units prior to deployment (POC: LtCol Torres, 366TH AMDS).

EMEDS Mobile Field Surgical Team

Pre-deployment—Logistics
1. Observation. The 59 MDW/MFST reported continued problems with lack of support from their logistics department.
2. Discussion. In order to deploy MFST backpacks, supplies had to be taken out of training packs. Inadequate supplies are available on re-stock shelves.
3. Recommendations. Current re-organization plan needs to be coordinated and operational by 20 Feb 99 (POC: Capt Craig Manifold, 59 MDW/MFST).

Infusion Dynamics Power Infusion
1. Observation. 240-gram infusion pump capable of infusing crystalloid intravenous fluids at 6 liters/hour.
2. Discussion. This lightweight battery or 110 AC powered infusion pump fits in the size of your palm and is capable of infusing fluids in the critically injured trauma patient. Its lightweight and small package size makes it usable by the MFST. It was tested and utilized during trauma resuscitations of our surgical animal models. The unit performed flawlessly during operations in the EMEDS environment.
3. Recommendation. Utilize and continue testing in hospital environment when FDA approved cartridges are available. Purchase units/cartridges/batteries for inclusion in EMEDS/MFST allowance standard (POC: Capt Craig Manifold, 59 MDW/MFST).

Impact 725 Portable Ventilator
1. Observation. 5 lb. portable ventilator currently under development by the IMPACT Corporation.
2. Discussion. A continuous mechanical ventilator (CMV) which currently weighs approx. 5 lbs. and is battery powered or 110 AC powered. This prototype unit was utilized on our animal models post-operatively. One animal was continuously ventilated for 5 hours on battery power. The ABG at the four-hour mark reflected adequate ventilation with a Ph 7.45, CO2 46, and PaO2 84. This unit has an internal compressor and does <u>not</u> require external compressed gases. Oxygen can be blended in the patient circuit. No patient alarms are available. Tidal Volume and rate are preset with five potential variations.
3. Recommendation. Continue animal model testing at Wilford Hall Medical Center. When unit commercially available, consider for certification by AFRL/HEPR for Patient Movement Item (PMI) prior to purchase (POC: Capt Craig Manifold, 59MDW/MFST).

Lixiscope Portable Fluoroscopy Unit
1. Observation. Hand-held portable fluoroscopic unit for extremity imaging.

2. Discussion. Too small for practical use. Imaging is restricted to the smaller parts of the body to include the hands, wrist and toes. Unable to visualize any of the long bones or joints to include the ankle, which is likely the most needed next to the hand. It is small and lightweight, but not very practical for any other use in EMEDS setting. Viewfinder is too small and only single side of long bones can be visualized. Appears to be difficult to utilize in operative setting to assist with K-wire fixation. Utilized in Emergency Department setting. ED resident was able to identify fractures of hand and foot prior to deployment.
3. Recommendation. Adequate imaging for small body parts, i.e. hand, foot, and wrist. Diagnostics decisions can not be made on proximal structures. Feedback provided to company. Re-evaluate product if improvements allow visualization of proximal structures (POC: Capt Andreshak, 59MDW/MFST).

ORCA C-arm Flouroscopy
1. Observation. Portable C-arm fluoroscopy unit for extremity imaging. Orthopedic requirements include a capability that will allow intra-operative visualization. This would be invaluable for treating fractures and placing pins/wires.
2. Discussion. The unit was able to image most joints in the body. Although not optimal the spine could be imaged through the wooden spine boards. A lateral C-spine could be visualized in a small shouldered person to include C7 – T1. There is a capability for storing images on to a floppy disc. Transmission therefore to anywhere in the world would be possible. Large size and weight are limitations of this unit. Unit provides required extremity imaging capabilities in EMEDS setting. Thoracic and abdominal imagining is not provided. Unit needs to be more compact and mobile for field conditions.
3. Recommendation. Manufacture has been made aware of need to increase size of wheels and provide flat screen monitor. Add unit to EMEDS Allowance Standard until smaller unit is commercially available (POC: LtCol Peter Muskat, 59MDW/MFST).

MinXRay Generator
1. Observation. Lightweight X-ray generator unit.
2. Discussion. Portable, durable x-ray unit capable of providing thoraco-abdominal and extremity plain films. Unit is compatible with Computerized Radiography (CR) systems. Proven durability in environments outside of hospitals and easily transported. Provides 100Kv capability. Images taken during exercise are available for review.
3. Recommendation. Purchase item (to be used in combination with the Lumisys CR system) for EMEDS+10 Allowance Standard (POC: LtCol Peter Muskat, 59MDW/MFST).

NarcoMed Field Anesthesia Unit
1 Observation. Field Anesthesia Unit (First operational use by MFST)
2. Discussion. 141 lbs, easy to assemble. Similar procedures to operate when compared to standard hospital based anesthesia machine. Works effectively in field environment. Set up accomplished easily without prior instruction. Instrument requires high-pressure (30 PSI) oxygen/air supply. Packing container is bulky, increasing pallet size requirement. Able to meet standard of care with this machine.
3. Recommendation. Initiate training at 59 MDW for anesthesia providers. Dedicate machine for training and develop training protocol for use on consenting patients (POC: LtCol Peter Muskat, 59MDW/MFST).

Field Sterilizer
1. Observation. Current field sterilizer is bulky and not compatible with shelter environmental control (i.e. excessive steam release).
2. Discussion. The portable field sterilizer requires a covered area attached to EMEDS that is vented to the outside. Historically, the field sterilizers have been located in vestibules attached to the sides/ends of temper tents or in a separate tent attached by a vestibule to the hospital proper. The field sterilizer re-

quires approximately 5 gallons of de-mineralized water for initial operation and must be replenished for continued operation.
3. Recommendation. At EMEDS Basic, provide a vestibule compatible with tent systems. At EMEDS+10, add a steam reclaimer system for sterilizer to Allowance Standard. Until cold/microwave sterilization process (Tactical Medical Solutions, Inc.) is available, need to research de-mineralizer system (POC: Major Nancy Young and Major Don Diesel).

Medical Research Lab's PIC Cardiac Monitor
1. Observation. MRL's PIC cardiac monitor and defibrillator worked well in actual patient care.
2. Discussion. Monitor combines several monitors into one (Defibrillator, AED, Pulse Ox, Pacer and 12 lead EKG). While this monitor worked well and would be a suitable choice for implementation, the physio-control Lifepak 12 has the same features and is the preferred machine.
3. Recommendation. Proceed with the first choice and provide the Life-pak 12 for use in EMEDS (Maj Kruger, 59th MDW/GCCT).

Animal Lab
1. Observation. Four porcine animal models were utilized to simulate traumatized patients. Animal models were triaged and resuscitated in the Emergency Department. They were taken to the operating suite (ASSTC/ Alaska) and underwent operative interventions to include: laparotomy, splenectomy, enterotomy repair, vascular shunt placement, external fixation, gastrostomy, supra-pubic cystostomy, and nephrectomy.
2. Discussion. Training objective for this phase of the exercise were met. The dental officer successfully augmented the surgical team. Preliminary assessment of patient flow indicated the current design of the ASSTC shelter was not acceptable. Animal lab was critical in the shelter assessment and provided invaluable training experience for EMEDS personnel.
3. Recommendation. Maximize animal lab and veterinary support to EMEDS training course. Animal lab study indicated that Alaska shelter is better suited for EMEDS mission (POC: LtCol Tyler Putnam).

1. Observation. No site security plan to support animal lab.
2. Discussion. The EMEDS force package cannot provide security to prevent unauthorized observers during animal labs. All EMEDS personnel were involved in the medical care of animal models.
3. Recommendation. Animal lab support should include physical security personnel (POC: LtCol Tyler Putnam).

EMEDS Critical Care

Resupply Issues
1. Observation. In a mass casualty incident, materials are used quickly. If one strategic item becomes exhausted, it can adversely impact mission capabilities.
2. Discussion. Following increased use of expendable supplies, such as in a mass casualty incident, prompt resupply will ensure continuing mission capability. Consider computerization of this function.
3. Recommendation. To make resupply more efficient and effective, bar coding each item and supplying a barcode reader to the team should be considered. Rather than submitting a list of required supplies to logistics, the barcode reader could communicate with them via datalink. This would minimize the resupply effort and help keep the team at full functional capability. (MSgt Tikalsky, 366th MDG).

Multi-functionality of Personnel
1. Observation. Critical care members will not be available to work for 24 consecutive hours indefinitely.

2. Discussion. Additional taskings and work rest cycles, will require other members of the EMEDS team to step in and perform critical care duties. Multi-functionality of EMEDS personnel is critical to the success of this UTC.
3. Recommendation. EMEDS-Basic course, currently under development, should emphasize multi-functional training. Home station should ensure personnel assigned to EMEDS are fully trained in assigned AFSC (POC: ACC/IPT).

Physician Training Requirements
1. Observation. Physicians assigned to FFEP2 (critical care) need to be current in their specialty.
2. Discussion. Critical care physician assigned to EMEDS was a general internist with little critical care experience.
3. Recommendation. A specific training course for the critical care physician should be established (POC: Major Kruger, 59 MDW).

Training Requirement for Critical Care Nurse
1. Observation. Critical Care nurses on FFEP2 need training and experience on procedures required in an EMEDS environment as well as basic knowledge of the use and troubleshooting of cardiopulmonary instrumentation. Critical care nurse is expected to be multi-funtional.
2. Discussion. Critical care nurses selected for EMEDS work either in their specialty or in special care units. EMEDS demands special training which may not occur in their normal duties. Specialized equipment on the EMEDS allowance standard is not routinely used in a fixed hospital setting. Critical care nurse must be proficient in emergency and general nursing practices.
3. Recommendation. Training requirements for the critical care nurse should be revised and geared to functioning in an EMEDS environment with capability of performing limited tasks of the cardiopulmonary technician (POC: Major Kruger, 59 MDW)

Training Requirement for Cardiopulmonary Technician
1. Observation. Training requirements for the FFEP2 cardiopulmonary technician should be revised to emphasize generalization and versatility rather than specialization.
2. Discussion. The trend for training and function of cardiopulmonary technicians emphasizes a greater degree of specialization regarding procedures and practices. Cardiopulmonary technicians are sourced from large medical centers performing specific duties in their specialty or in smaller hospitals performing primarily spirometry and EKGs.
3. Recommendation. Training requirements for the cardiopulmonary technician should be revised with curriculum geared toward generality (to include EMT certification) with capability of performing many tasks not particularly within their specialty (POC: Major Kruger, 59 MDW).

Specialty Team Retainability
1. Observation. Critical care team (FFEP2) should receive specialty training but attrition could adversely impact their functionality and cohesiveness.
2. Discussion. There should be increased training requirements for members of the team. It may be difficult to ensure that all general internists, critical care nurses, and cardiopulmonary technicians are continuously up to date on training. Furthermore, attrition from the team can occur with PCS moves and separations. In this situation, all members of the team may not be current with training.
3. Recommendation. Consider selecting members of a FFEP2 team from a pool of motivated, energetic volunteers who have two years retainability on station and appoint them to an EMEDS team. Allow them to receive much of their refresher training together to promote the team concept. Rather than deploying persons individually, consider deploying the entire team who knows how to work together and who are aware of the responsibilities of the other team members (Maj Kruger, 59TH MDW).

Team Chief Summary.

The EMEDS unit exceeded expectations. EMEDS personnel UTCs (FFGL2, FFEP1, FFEP2, FFEP3) and equipment package (FFEE1) were effectively embedded into the 366 EMEDS. Surgical capabilities and post-operative care were tested utilizing animal models. It was evident that critical care and pre-op and post-op care could be provided with quality in an EMEDS setting. An EMEDS training course needs to be established with emphasis on multi-functional skill sets. Specific AFSC and appropriate refresher training must be accomplished locally.

Although we feel that the Alaska shelter was superior to the ASSTC for patient flow and surgical capabilities, we must await the final report from AFOTEC. Multiple medical equipment items were tested and evaluated. F4 provided an ideal place for the initial validation of the EMEDS concept. All established objectives were accomplished

CRESCENCIO TORRES, LtCol, USAF, MC, SFS
EMEDS Commander

Attachment:
1. List of Medical Personnel Deployed

cc: Deployed Squadron Unit Cmdrs

Medical Personnel Deployed

Lt Col Torres, Commander
Maj Andreshak, MFST
Maj Kruger, GCCAT Team Leader
Maj Smith, MFST
Capt Freed, EMEDS
Capt Gleason, EMEDS FSO Team Leader
Capt Hubbard, GCCAT
Capt Manifold, MFST Team Leader
Capt Mcbay, MFST
Capt Rasmussen, EMEDS Nursing Team Leader
Capt Rodgers, MFST
Capt Vogl, EMEDS
1Lt Neuenfeldt, EMEDS
2Lt Eckley, EMEDS
MSgt Casso Lopez, EMEDS First Sergeant
TSgt Noeller, GCCAT
TSgt Taylor, EMEDS
SSgt Robbins, EMEDS
SSgt Richards, EMEDS
SSgt Skrok, EMEDS
SSgt Farson, EMEDS
SrA Guillen, EMEDS
A1C Bills, EMEDS
A1C Godsey, EMEDS

Requirement/Modifications to SSS for Use as a Medical Facility

The Air Expeditionary Force (AEF) Battle Lab has identified a need to adapt the Small Shelter System (SSS) for use as a Medical Facility. The capability of the SSS to meet this mission was demonstrated at Nellis AFB's Camp Cobra during the week of 1 Feb 99. The feedback from the Medical community was extremely positive. However, several mission specific features were identified as needed to insure maximum effectiveness of the system.

A commercial type Vestibule (connector) will be needed and priced separately from other modifications to the shelter.

There will be no modification that may preclude the complex from being made into a Nuclear, Chemical, and Biological compatible system in the future.

Any proposed modifications to the shelter for Medical use should conform to the following Modification Methods as described below.

Modification Method 1 Add on kit.
This is the preferred method of modifying the system. In this method, a set of components is added to the SSS without any modification to the basic system. In this case, a complete SSS will be ordered as normal, with an add-on kit provided to meet certain capabilities for medical use. Add to contract a "medical adapter kit"

Modification Method 2 Deletion kit
This method will mean that a certain component, or set of components, will be deleted from the basic configuration.

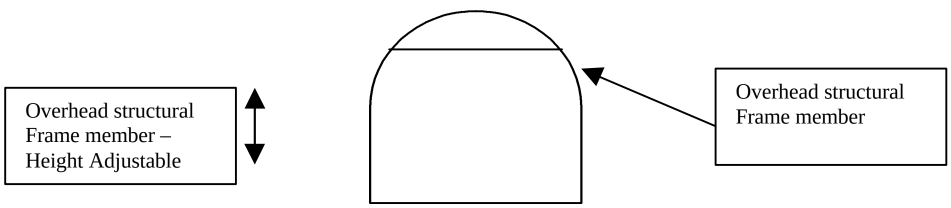
Modification Method 3 Deletion and Replacement kit
This method will mean that a certain component, or set of components, will be deleted from the basic configuration, and those same components be replaced with similar components that are modified for the required capabilities. All modifications made under this method must be compatible with the basic SSS.

Modification Method 4 Modification to Basic System **(THIS IS NOT DESIRED)**
Under this method, the components of SSS will be altered in a manner that makes the components only usable for a certain configuration, and will no longer be compatible with the basic SSS.

<u>The following changes to the Basic Small Shelter System will be needed, and are in order of importance</u>.

<u>Modification 1</u> - Surgery Suite. (Only 1 out of every 9 shelters will be this configuration)

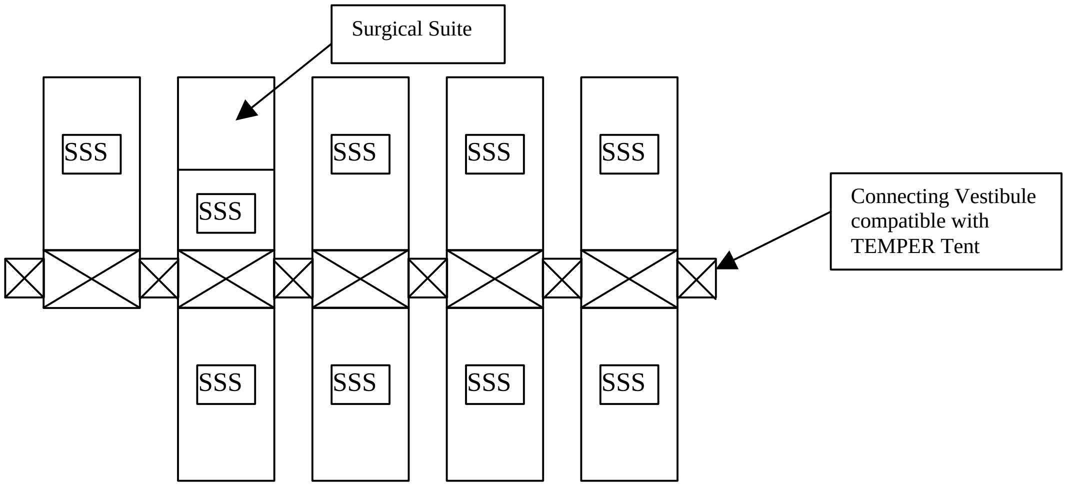
It is required that a portion of the shelter approximately 13’ x 20’ in size be partitioned off for a surgical suite. It is further required that the airflow through this partitioned area be a positive pressure environment with no direct return path to the ECU. This will help to control dust and contaminates in the surgical area. Airflow should exit the surgical area into the remainder of the shelter, and then into the return of the ECU. The partitioned off area should include a door to access the area and see-through windows that can function as a pass through for medical supplies or other small equipment. It is required that the partitioned off area be as well sealed and sanitary as possible. It is desired that an overhead structural frame member be provided in the surgical suite. The frame member should be adjustable in the vertical direction, and be designed to support 150 lbs. of equipment such as lights, power cords, and other surgical and medical equipment. See figure below for concept.



It is required the ECU have additional filtration for use with the surgical suite. HEPA or other types of ASHRAE rated filters are not required. A good commercial quality electrostatic filter will suffice. It is required that the filter be washable and reusable. It is not desired that the ECU be modified in any way other than to accept replacement filter. It is understood, by the Government, that this filter will require maintenance on a accelerated basis over the standard filter.

Modification 2 – Complexing with Vestibule

It is required that the shelters be complexed in the manner shown in the diagram below. The complexing components should be designed with all the original requirements and specifications as stated in the System Performance Specification in the Small Shelter System contract. The complexing components should also serve to make the system compatible with the TEMPER Tent by providing a connecting vestibule.



Modification 3

It is required that the floor area in the surgical suite area be made more durable. The area in the suite is expected to receive heavy use, and holes in the floor are extremely undesirable due to sanitation concerns. The sanitation concerns are twofold; first, it is undesirable that dust and dirt from under the shelter be allowed to migrate into the surgical area, and second, that biomedical fluid such as blood should not be allowed to seep into the area beneath the shelter. The floor should contain all spills and be easy to clean.

Modification 4

It is desired that some type of ramping system be provided for use at the doors of the Small Shelter System. It is a concern that the base frame, while providing vector control and other positive benefits, may pose a tripping hazard when medical personnel are carrying a litter with a injured person.

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Below is an after action report from Maj Jim Sylvester regarding the F4 exercise. Maj Sylvester is from AFRL Human Performance Directorate and does airworthiness testing of medical equipment. He participated in the F4 exercise to help assess the equipment as well as shelters.

15-Feb-99
MEMORANDUM FOR AEFB/MDG, Battle Laboratory
ATTN: MAJOR DON DIESEL
FROM: AFRL/HEPR (MAJOR JAMES C. SYLVESTER)
SUBJECT: Field Report

1. Thank you for your support of my TDY to Nellis AFB, Camp Cobra during the Form, Fit, and Function, Follow-on (F-4) Assessment from the 1st through 5th of February 1999. This is a brief synopsis of my thoughts and concerns about the Expeditionary Medical Support UTC and Compact Air Transportable Hospital (CATH).

2. Manning levels are at critical levels with only 24 assigned members.

There was much discussion concerning the dual role of flight surgeons and aerospace medicine technicians directly on the flight line interacting with flight crews and their role in the EMEDS. While this issue continued to be worked as my participation came to an end, I believe flight line duties away from the EMEDS for these personnel are best limited to defined sick call hours and responding to flight line emergencies.

Maintaining a continuous medical staff presence on the flight line environment removes 10 percent of your staff from the EMEDS at any given time. I must assume 24 hour a day operations or at least a continuous threat necessitating continuous flight line coverage. If a continuous flight line presence is desired a UTC Air Transportable Clinic could be mobilized.

3. Another area of concern is the clinical experience level of assigned nurses and medical technicians. As the USAF Medical Service continues to contract, finding the right clinical expertise will be tested to the maximum extent possible. Relatively few nurses or technicians have either Emergency Room or Intensive Care experience today in the USAF. The number of nurses and technicians having experience in both areas is even less. Clinical expertise and judgment in both settings are not necessarily synonymous. The differences become more acute when one considers substituting aerospace medicine technicians to the mix as replacements for medical technicians.

There will be difficulties fielding fully qualified staff and also in keeping qualified staff trained.

4. The CATH patient treatment exercise was most revealing in its comparison of the Alaska Shelter versus the Advanced Surgical Suite for Trauma (ASSTC). The ASSTC advertised floor space was stated to be 900 square feet.1 However, the ASSTC is circular so its area is defined as area=(3.14) X diameter2, not a rectangle=width X length. Square footage of the ASSTC with a measured diameter of 30 feet is approximately 706 square feet. This compares favorably with the verified dimensions of the Alaska Shelter, approximately 650 square feet.

5. Patient treatment and surgical scenarios showed several ASSTC disadvantages. The central surgical suite is approximately 108 square feet (9 X 12 feet). This space is too small for two concurrent surgeries. The introduction of an expansion package to the EMEDS to "plus 25" would necessitate introduction of a 2nd ASSTC. Using two fifths of an Alsaka Shelter yields 260 square feet. The surgeons present when interviewed felt this Alaska Shelter space could accommodate two concurrent surgeries.

The ASSTC design built around a centralized surgical suite created patient visibility and staff communication problems. Staff could not see or communicate around its corners. There were also complaints about shelf and cabinet design in the operating theater for surgical instrument storage and access during surgery.

6. The power cord to the surgical suite runs along under the bottom the ASSTC liner. This creates a potential tripping hazard and is subject to accelerated wear and tear due to foot traffic.

7. Infection control issues also arose concerning the ASSTC surgical suite's piano hinge flooring. Blood seeped into the hinges and dripped below onto the ground. This could be corrected with some sort of rubberized liner.

8. The Alaska Shelter presented its own limitations to surgery. The heater/air conditioning duct system requires modification to eliminate its impeding on the surgical arena. Air flow is an infection control issue as air flow is pulled through the surgical arena instead of from it as in the ASSTC to other tent areas. This could be alleviated with additional air return duct work with intakes outside the surgical suite. The floor was easily cleaned after surgery.

9. The Alaska Shelter floor needs to be more durable. Moving heavy objects across it showed wear and tear marks indicating failure of floor integrity was not far in the future. The need for a connecting vestibule to allow interconnection of Alaska Shelters at right angles was a universal finding by all participants.

10. I prefer the Alaska Shelter over the ASSTC. Exclusive use of Alaska Shelters simplifies tent erection training. Surgical space is adequate for two concurrent surgeries to occur. Eliminating ASSTC decreases components to be kept on hand in the inventory for repair/replacement. There are cube and weight savings realized in load out when pallets contain an additional Alaska Shelter versus a ASSTC transport box.

11. First, a general comment about medical and electronic equipment chosen for the EMEDS. Most devices were Commercial-Off-The-Shelf Devices.

Some were clearly designed for out of hospital use others were for in-hospital use only. Survivability in the EMEDS environment should be of concern for every electrical device selected. Dust, humidity, vibration, and temperature changes will be continuous threats to this equipment.

Reliability over the long term should not be assumed, but actively investigated. Manufacturer testing can accessed when available. A smaller footprint leaves little room for error. Aeromedical testing has been done on some items such as the Propaq 206EL by AFRL/HEPR. The U.S. Navy has a facility capable of conducting dust testing.

12. Sterilizer - It is bulky and there is no good way to incorporate it into the Alaska Shelter design without major modifications. During the exercise, it was kept outside an Alaska Shelter. It generates steam by design and unless vented to the outside would create a tropical environment inside any tent with frequent use. Hardening the shelter for chemical and biological threats will necessitate incorporation of the sterilizer inside the EMEDS. Efforts should be made to contact Association of Professionals in Infection Control & Epidemiology (APIC) and the Food & Drug Administration (FDA) to identify near horizon technologies which may allow rapid sterilization of instruments without such bulky equipment and older technology. Microwave technology applications and new rapid sterilization fluids may be available in the near future.

13. PIC System by MRL - It offers few advantages over the Propaq 206EL Encore monitors in the patient holding area. Does every patient need access to their own private defibrillator? It does offer improvements to the LifePak 10 cardiac monitor/defibrillator on ambulance responses with its additional features such as NIBP and expiratory carbon dioxide monitoring capability. The NIBP feature is a nice plus, but I believe Propaq offers this option as an upgrade to its' 206EL monitors as well.

14. Micro-paq Field Anesthesia machine - Offering a significantly smaller and lighter than the NarkoMed device, this machine was unable to be demonstrated due to technical problems. Further consideration of this device should await FDA 510K approval. The NarkoMed Device performed without incident.

15. Patient Ventilation Oxygen Concentrator System (PVOCS) - This system offers enough oxygen delivery at 93+3 % to probably operate four ventilators. Demonstration of this capability is recommended to assure performance. The need for compressed gaseous oxygen storage in cylinders for use in ambulances and as an emergency backup for this technology in case of electrical power outage needs to be carefully weighed. Moving away from 99% USP grade oxygen to a lower maximum concentration will be a major shift in clinical practice for some providers. However, few patients in clinical practice receive oxygen concentration at this level for any amount of time.

Demonstration of clinical response of patient physiological parameters to these different maximum concentrations could be performed if this is of concern.

16. Several staff members were interviewed. No additional medical equipment was identified as possible procurement items based on these interviews. Staff members reported they had the right equipment and supplies to do the job. Particulars such as type and number of lap top computers continue to be discussed. Movement to a paperless system for patient care recording appears sound.

17. In conclusion, the basic operational needs of the EMEDS can be met with the personnel and medical equipment demonstrated during the F-4.

Progress continues to refine personnel and equipment requirements to make it even better. Thank you for inviting AFRL representatives to participate in F-4. 1Lt Donovan and I enjoyed our week with your very capable staff. EMED staff, evaluators, accommodations, and the chow was outstanding.

JAMES C. SYLVESTER, Major, USAF, NC
Chief, Air Force Medical Equipment Development Lab